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NATIONAL DAM INSPECTION PROGRAM. NUMBER 5 DAM (NDI ID NUMBER PA--ETC(U)
APR 79 A C HOOKE DACW31-79-C-0015

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1 OF 1
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SUSQUEHANNA RIVER BASIN
STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM

NDI ID NO. PA-00375
DER ID NO. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

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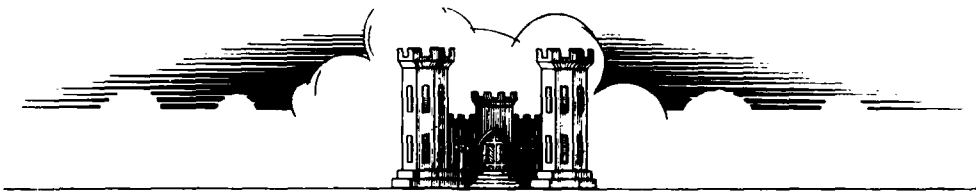

Prepared by
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Consulting Engineers
Harrisburg, Pennsylvania 17105

For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

APRIL 1979

(15) DACW31-77-C-0015

SUSQUEHANNA RIVER BASIN

STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

(6) National Dam Inspection Program.
Number [redacted] 5 DAM

(NDI ID Number [redacted] PA-00375
DER ID Number [redacted] 35-22),

~~PENNSYLVANIA GAS AND WATER COMPANY~~,
Susquehanna River Basin, Stafford Meadow Brook
Lackawanna County, Pennsylvania.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

Prepared by

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DEPARTMENT OF THE ARMY
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Baltimore, Maryland 21203

(11) Apr[redacted]79

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

SUSQUEHANNA RIVER BASIN

STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

April 1979

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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	No. 5 NDI ID No. PA-00375/DER ID No. 35-22D
Owner:	Pennsylvania Gas and Water Company
State Located:	Pennsylvania
County Located:	Lackawanna
Stream:	Stafford Meadow Brook
Date of Inspection:	8 November 1978
Inspection Team:	Gannett Fleming Corddry and Carpenter, Inc. Consulting Engineers P.O. Box 1963 Harrisburg, Pennsylvania 17105

Based on visual inspection, available records, calculations, and past operational performance, and according to criteria established for these studies, No. 5 Dam is judged to be unsafe, nonemergency, because the spillway capacity is rated as seriously inadequate. The spillway can pass 29 percent of the Probable Maximum Flood (PMF) without overtopping of the dam. Failure of the dam would cause an increase hazard to loss of life downstream. As a whole, the dam is judged to be in fair condition.

The spillway gravity weir does not have any significant deviations from the guidelines for stability, since the toe pressure is well below the allowable. There is no evidence of instability on the embankment.

The following measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform additional studies to more accurately ascertain the spillway capacity required for No. 5 Dam, as

well as the nature and extent of the mitigation measures required to make the spillway hydraulically adequate. Take remedial measures as required. The studies should be performed by a professional engineer experienced in the design and construction of dams.

(2) Repair the concrete at the spillway weir and the corewall.

(3) Repair the vandalized interior of the intake structure so that adequate access to the upstream closure valves is available. Ensure that the valves are operational.

(4) Repair the mortar at the spillway and at the masonary gravity training wall.

(5) Replace the dislodged capstones at the outlet works approach wall.

(6) Repair the riprap on the upstream slope of the embankment.

(7) Provide a proper surface drainage path near the right abutment.

(8) Monitor, by any suitable means, the seepage at the spillway channel. If significant changes are noted, take appropriate action.

(9) Monitor, by any suitable means, the depression behind the dry masonry wall. If changes are noted, take appropriate action.

In addition, it is recommended that the Owner modify his operational procedures as follows:

(1) Develop a detailed emergency operation and warning system for No. 5 Dam. A similar system has already been recommended in other reports for Lake Scranton and Williams Bridge Dams, which are located upstream.

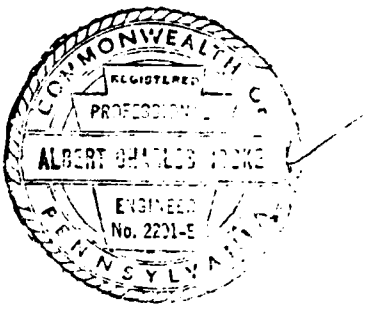
(2) Provide round-the-clock surveillance of No. 5 Dam during periods of unusually heavy rains.

(3) Develop impediments to trail bike use on the embankment and improve security at the damsite.

(4) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.



A. C. HOOKE
~~Head, Dam~~ Section

Date: 30 April 1979

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

NO. 5 DAM

Overview

SUSQUEHANNA RIVER BASIN

STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

SECTION 1

PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. No. 5 Dam is a homogeneous earthfill embankment with a masonry core-wall. A concrete cap is on top of the core-wall and the cap protrudes from 3 to 4 feet above the embankment. The dam is 248 feet long and 35 feet high at its maximum section.

The masonry gravity spillway is at the left abutment of the dam. A parabolic-shaped concrete weir is atop the masonry. The crest is 86.1 feet long and 7.3 feet below

the design top elevation of the dam. A masonry gravity wall extends along the right side of the spillway channel. It acts as the spillway training wall and also retains the embankment.

The outlet works is about in the middle of the embankment. The intake structure is located along the axis of the embankment. Masonry gravity approach walls extend along both sides of the approach channel to retain the embankment. Valves for both the 24-inch diameter cast-iron pipe (CIP) emergency drawdown line and the 18-inch diameter CIP water supply line are located in the intake structure. Other valves for these lines are located in valve pits near the downstream toe of the embankment.

b. Location. The dam is located on Stafford Meadow Brook approximately 3.4 miles south from the center of Scranton, Pennsylvania. No. 5 Dam is shown on USGS Quadrangle, Avoca, Pennsylvania, with coordinates N41°21'40" and W75°40'15" in Lackawanna County, Pennsylvania. Lake Scranton Dam is 2.3 miles upstream from No. 5 Dam. Williams Bridge Dam is about 0.8 mile upstream from Lake Scranton Dam. A location Map is shown on Plate 1.

c. Size Classification. Small (35 feet high, 206 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for No. 5 Dam (Paragraph 5.1c.).

e. Ownership. Pennsylvania Gas and Water Company, Wilkes-Barre, Pennsylvania.

f. Purpose of Dam. Previous use was water supply. At present, the dam is used as a contingency water supply intake for Lake Scranton Dam.

g. Design and Construction History. No. 5 Dam was constructed between 1887 and 1888. It was designed by E. Sherman Gould, consulting engineer of Scranton. The dam was constructed by Burke Brothers, Contractors of Wilkes-Barre, under the supervision of William Marple. The original dam was 18 feet high and was constructed with a vertical masonry downstream face and with earthfill, extending to within 1.5 feet of the top, along the upstream side on a 1V on 4.5H slope. Two buttresses were provided along the downstream face of the dam.

In 1893, the dam was raised by increasing the height of the masonry by 10 feet. The masonry was then covered by 2 feet of earthfill, which was extended both upstream and downstream. Thus the original masonry dam is the core-wall of the existing structure. Mr. Marple supervised this work also.

The dam was studied in 1914 by the Pennsylvania Water Supply Commission. The study indicated that the upper portion of the masonry gravity section had its resultant only 0.05 foot inside the base. These results were confirmed by Professor Frank McKibben of Lehigh University, as a consultant to the Water Supply Commission. Remedial measures were ordered.

In 1916, the dam was modified to its present configuration by constructing the parabolic-shaped concrete cap on the spillway weir to improve the stability. A concrete cap was added to the core-wall at the same time; the cap is about 6 feet in height and extends about 4 feet above the embankment.

h. Normal Operational Procedure. The pool is maintained at spillway crest with excess inflow discharged over the spillway.

1.3 Pertinent Data.

a. Drainage Area. (square miles.)	12.0
b. Discharge at Damsite. (cfs.)	
Maximum known flood at damsite	unknown
Outlet works at maximum pool elevation	80
Spillway capacity at maximum pool elevation	5,940
c. Elevation. (feet above msl.)	
Top of dam (design)	929.5
Top of dam (existing)	See Section 5.
Maximum pool	929.5
Normal pool	922.2
Upstream invert outlet works	Not available

c.	Elevation (Cont'd)	
	Downstream invert outlet works	895.1
	Streambed at toe of dam	894.3
d.	Reservoir Length. (miles.)	
	Normal pool	0.2
	Maximum pool	0.3
e.	Storage. (acre-feet.)	
	Normal pool	98
	Maximum pool	206
f.	Reservoir Surface. (acres.)	
	Normal pool	9.8
	Maximum pool	20.3
g.	Dam.	
	Type	Homogeneous earthfill with masonry core-wall, which is extended with concrete above the earthfill.
	Length (feet)	248
	Height (feet)	35
	Topwidth (feet)	
	Concrete cap	3.0
	Earthfill	Varies; about 12, minimum
	Side Slopes - Upstream -	Irregular, about 1V on 3.5H

g.	Dam (Cont'd)	
	Downstream -	Varies- 1V on 1.9H to 1V on 2.4H
	Zoning	Homogeneous earthfill
	Cutoff	Core-wall
	Grout Curtain	None
h.	Diversion and Regulating Tunnel.	None
i.	Spillway.	
	Type	Masonry-gravity weir with parabolic-shaped concrete crest
	Length of Weir (feet)	86.1
	Crest of Elevation	922.2
	Upstream Channel	Reservoir
	Downstream Channel	Natural stream in bedrock. Masonry-gravity training wall on right.
j.	Regulating Outlets.	
	Type	24-inch diameter cast-iron pipe.
	Length (feet)	118
	Closure	24-inch gate valves. One at intake structure, Another near downstream toe of dam.

j. Regulating Outlets (Cont'd)

Access	Intake structure-see Section 3. Valve near toe in valve pit.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. No engineering data were available for review for the structure as originally designed or for the 1893 modifications. In a study performed in 1914 by the Pennsylvania Water Supply Commission, an account of design concepts, geology, construction materials and methods, and design features was prepared for the components of the dam from interviews with the Owner, visual inspection, and other sources. The 1914 study also included analyses for hydrology and hydraulics and structural stability. A summary of the results of the analyses is on file. Some engineering data for the 1916 modification to the dam is available.

b. Design Features. The project is described in Paragraph 1.2g. The various features of the dam are shown on Plates at the end of the report and on the Photographs in Appendix D. The plan of the dam is shown on Plate 2. The profile is shown on Plate 3. Views of the embankment are shown on Photographs A, B, C, and D. Cross sections of the embankment are shown on Plate 4. The spillway is shown on Photographs E, F, and G. Spillway sections are shown on Plate 5, which also has a summary of the stability analysis for the 1916 modification. The outlet works is shown on Photograph H. A plan of the outlet works is on Plate 2.

c. Design Considerations. There are no particular concerns about the design of the dam, except for the capacity of the spillway, which is discussed in Section 5.

2.2 Construction.

a. Data Available. Construction data for the original structure that are available for review, consists of the information contained in the 1914 report prepared by the Pennsylvania Water Supply Commission. Site geology is discussed in Appendix E. The report states that the original masonry of the dam was extended about 10 feet below the original ground surface to a compact and impervious hardpan foundation. The overexcavation was then backfilled with selected material. The lower elevations of the embankment were constructed with a mixture of loam, sand, and clay. The upper elevations were constructed of sand, loam, and "small stones". The 6-inch to 12-inch lifts were not rolled, but compacted by the travel of earth moving equipment.

b. Construction Considerations. It appears that reasonable care was used in the construction of No. 5 Dam. Although the compaction of the embankment might have been better, it has existed for 92 years without any reported problems.

2.3 Operation. There are no formal records of operation. The Owner did not report any problems having occurred over the operational history of the dam.

2.4 Evaluation.

a. Availability. Engineering data was provided by the Bureau of Dam Safety, Obstructions, and Storm Water Management; Department of Environmental Resources, Commonwealth of Pennsylvania, and by the Owner, Pennsylvania Gas and Water Company. The Owner made available an engineer for information. He also researched his files for additional data at the request of the inspection team.

b. Adequacy. The type and amount of design data and other engineering data are limited, and the assessment must be based on the combination of available data, visual inspection, performance history, hydrologic assumptions, and hydraulic assumptions.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The overall appearance of the dam is good. However, some deficiencies were observed as noted below. A sketch of the dam with the location of deficiencies is presented in Appendix B on Plate B-1. Survey information acquired for this report is summarized in Appendix B. On the day of the inspection, the pool was 0.1 foot above the spillway crest.

b. Embankment. The embankment is in generally good condition. Trail bike ruts extend up the downstream slope to the left of the intake structure (Photograph H). A surface drainage swale is at the right abutment. A minor amount of erosion was observed at the swale. Left of the intake structure, the riprap on the upstream slope is washed out. It is also washed out for 20 feet to the right of the structure. The remainder of the slope is covered with riprap, which is obscured by tall grass (Photograph C). The riprap in this area appears in good condition. The core-wall extension, above the top of the embankment, is in poor condition. The concrete is spalled and peeling over 70 percent of the wall (Photograph D). The survey performed for this inspection revealed that the top of the core-wall is at elevation 929.9, which is 0.4 foot above the design elevation, except where the concrete is severely spalled. The severest spalling is at the vertical joints in the wall. The wall has spalled down a distance of 0.7 foot at one joint (Photograph D).

c. Appurtenant Structures. The spillway is in fair condition. The concrete weir, which was added to the original masonry spillway in 1916, is very deteriorated. The reinforcing bars are completely exposed along the top of the weir (Photographs E and F). The mortar in the masonry section of the spillway is slightly deteriorated. The masonry training wall to the right of the spillway is leaching along its face (Photograph G). The mortar in the upper 3 feet of the wall is deteriorated. At the left of the spillway channel there are two minor seeps from the bedrock about 4 feet above the bottom of the channel. Downstream of the masonry training wall, a low, dry masonry wall extends for a short reach. The soil immediately behind this wall is depressed. The dry masonry wall is downstream from the toe of the embankment.

The operation of the outlet works was observed. The outlet works valve near the downstream toe was opened 5 percent by two men in 15 minutes with no apparent problems. The valves in the intake structure provide upstream closure for the outlet works. Their operation was not observed on the day of the inspection. The interior of the intake structure has been vandalized. The access ladder and debris are at the bottom of the valve pit. The Owner has provided steel shutters to prevent further vandalism. The window ledges and door sill are raised by concrete lips to 0.2 foot above the design elevation of the top of the dam. The capstones on the outlet works masonry gravity approach walls are dislodged (Photograph C).

d. Reservoir Area. All of the watershed that is downstream from Lake Scranton Dam is steep and wooded. It is also undeveloped and uninhabited. It is owned and controlled by the Pennsylvania Gas and Water Company. The access road to the dam, from Lake Scranton Dam, generally parallels the stream and crosses over it a few times.

e. Downstream Conditions. From the dam, the stream flows for 0.5 mile in a fairly steep and wooded reach until it passes under a railroad bridge. The stream then turns right and flows for 1.5 miles through a relatively flat and wide valley which generally parallels Interstate 81 on the left. In this reach the stream passes under a railroad embankment on three occasions. At the end of the reach, the stream turns left and passes under the Interstate 81 bridge, which is high overhead. The stream then flows for 1.1 miles through the City of Scranton to the Lackawanna River. In this reach, which is a major urban area, the stream passes through many small culverts and is adjacent to numerous dwellings.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at spillway crest, Elevation 922.2, with excess inflow discharging over the spillway and into Stafford Meadow Brook. Water supply lines at the dam are connected directly to the Owner's distribution system. The Owner stated that, although Pennsylvania Gas and Water Company is responsible for the dam, it serves no purpose at present. However, the water supply line is connected to the distribution system, and the dam could be used for water supply.

4.2 Maintenance of Dam. The dam is visited weekly by a caretaker who records the reservoir elevation. Weekly reports are mailed to the Owner's Engineering Department. This information is taken for record purposes only. The caretaker is also responsible for observing the general condition of the dam and appurtenant structures and reporting any changes or deficiencies to the Owner's Engineering Department. A Pennsylvania Gas and Water Company engineer makes a formal inspection of the dam each year, and the records are filed and used for determining the priority of repairs. Informal inspections are also made when the engineer is on the site for other reasons.

4.3 Maintenance of Operating Facilities. The water supply line and outlet works valves used to be operated frequently, when the dam was operational. The caretaker stated that recently the operation of the valves was infrequent since the dam is not considered operational. In response to the National Dam Inspection Program of the previous year, the Owner is in the process of modifying his maintenance procedures. Details of the procedures have not been fully formulated.

4.4 Warning Systems in Effect. The Owner furnished the inspection team with a verbal description of the chain of command diagram for No. 5 Dam and of a generalized emergency notification list that is applicable for all of the Pennsylvania Gas and Water Company dams. The Owner said that during periods of heavy rainfall, available personnel are dispatched to the dams to observe conditions. All company vehicles are equipped with radios, and the personnel can communicate with each other and with a central control facility. Evaluation

of risk is made by the Owner's Engineering Department. The Owner's Engineering Department is also responsible for notification of emergency conditions to the local authorities. Detailed emergency operational procedures have not been formally established for No. 5 Dam, but are as directed by the Owner's Engineering Department.

4.5 Evaluation of Operational Adequacy. More frequent operation of the valves on the emergency drawdown line appears to be warranted, although the downstream valve on the line operated adequately on the day of the inspection. The damsite is remote, and security appears to be a major problem. The vandalized valve pit leaves the dam with no readily available upstream closure facilities. The maintenance of the embankment is good, but the trail bike ruts indicate that security measures could be improved. The procedures used by the Owner for inspecting the dam are adequate, but some needed repairs have not been made. In general, the warning system is adequate, but it would be more effective if it were more detailed.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features

a. Design Data. The Pennsylvania Water Supply Commission prepared a report upon the application of the Owner, prior to issuing a permit for the 1916 modifications to the dam. In that report, they estimated the design spillway capacity at 3,670 cfs with 2.0 feet of freeboard. A design discharge of 5,940 cfs was used for this study, and is in agreement with the discharge noted above, except that the capacity was estimated with no freeboard. There is other data pertaining to the spillway before the 1916 modification; however, it is not relevant to the existing condition.

b. Experience Data. No hydraulic problems were reported by the Owner. He stated that no records of maximum pool levels were available.

c. Visual Observations

(1) General. The visual inspection of No. 5 Dam, which is described in Section 3, resulted in a number of observations relevant to hydrology and hydraulics. These observations are evaluated herein for the various features.

(2) Embankment. The spillway capacity is rated with the core-wall at its design elevation. Most of the core-wall is 0.4 foot above the design elevation. This additional height does not have a significant effect on the conclusions described hereafter. The spalled low area in the core-wall, 0.3 foot below the design elevation, would allow water to pass through the core-wall; this is a definite erosion hazard. The cause of the condition is assessed in Section 6.

(3) Appurtenant Structures. No deficiencies relevant to hydrology and hydraulics were observed at the spillway. The conditions at the outlet works intake structure are evaluated in Section 4.

(4) Reservoir Area. No conditions were observed in the reservoir area that might present significant hazard to the dam. The assessment of the dam is based on existing conditions and the effects of future development are not considered.

Phase I reports for the National Dam Inspection Program were previously prepared for Lake Scranton Dam and Williams Bridge Dam, both of which are upstream of No. 5 Dam. Both these dams are of intermediate size and categorized as high hazard. They both have seriously inadequate spillway capacities. The failure of either of the upstream dams would cause the failure of No. 5 Dam. Although the access road to the dam was in good condition on the day of the inspection, it is almost certain that it would be impassable during periods of high runoff.

(5) Downstream Conditions. No conditions that would present a hazard to the dam were observed downstream. The downstream conditions indicate that a high hazard classification is warranted for No. 5 Dam. The stream crossings under the railroad along the downstream channel were not observed on the day of the inspection. The available information indicates that the embankments are relatively low; they would not provide significant mitigating effects to floodflows.

d. Overtopping Potential

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of Engineers (OCE), the spillway design flood (SDF) for the size (Small) and hazard potential (High) of No. 5 Dam varies between the probable maximum flood (PMF) and the 1/2 PMF. Because of the very large downstream population, the PMF is selected as the SDF.

(2) Description of Model. The watershed was modelled with the HEC-1DB computer program. The HEC-1DB computer program computes a PMF runoff hydrograph and routes the flows through both reservoirs and stream sections. In addition, it has the capability to simulate an overtopping dam failure.

The PMF inflow component to Williams Bridge Dam was computed and routed through the dam. The outflow was routed downstream. This flow was added to the uncontrolled PMF inflow component to Lake Scranton Dam. The combined flow was routed through Lake Scranton Dam and downstream to No. 5 Reservoir, where it was combined with the uncontrolled PMF inflow component to No. 5 Dam. The combined flow was routed through No. 5 Dam. Identical methods were used for various percentages of the PMF.

(3) Summary of Results. Pertinent results are tabularized at the end of Appendix C. The analysis reveals that Williams Bridge Dam and Lake Scranton Dam can pass 45 percent and 34 percent, respectively, of their components of the PMF. The analysis also reveals that No. 5 Dam can pass 29 percent of the PMF without overtopping.

(4) Spillway Adequacy. The criteria for rating a spillway is presented in Appendix C. Since the dam cannot pass the 1/2 PMF, a further analysis was performed. For the occurence of the 1/2 PMF, it was assumed that Lake Scranton Dam and Williams Bridge Dam would not fail. It was also assumed that no inflow occured downstream of No. 5 Dam. In addition, it was assumed that No. 5 Dam would develop a breach 85 feet wide and 35 feet high 0.2 hour after being overtopped by 1.0 foot. A breach of this size results in an outflow of 27,300 cfs. The resulting outflow was routed downstream to Scranton. The locations of cross sections used for routing are shown on Plate C-1. The peak discharge at Scranton would only increase by about 1,190 cfs over the 10,790 cfs that would occur if the dam did not fail. The normal depth calculations used in the model indicate that the water surface in Scranton, resulting from the failure of the dam would rise only 0.2 foot over the peak non-failure water surface. The major reason for the negligible increase in water surface is the valley storage available between the dam and Scranton. However, there are conditions that would make the dam failure worse than the results of the analysis indicate. Plate 1 shows Interstate 81 crossing the left overbank of the stream in the reach between the dam and Scranton. As the road is high in this area, the roadway embankment may encroach significantly on the stream overbank. The computed valley storage may not all be available. The normal depth calculations used in the model do not take into account the effects of culvert flow. Pressure pipe calculations indicate that the water surface would increase by 23 percent (0.9 foot) for the computed discharge. Furthermore, the model analysis indicates that the peak failure water surface in Scranton would occur 2.0 hours before the peak non-failure water surface, only 20 minutes after the dam failed. Because of the above, the failure of No. 5 Dam would probably result in an increased hazard to loss of life. The spillway capacity of No. 5 Dam is rated as seriously inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of No. 5 Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for the various features.

(2) Embankment. The trail bike ruts damage the embankment. The swale at the right abutment indicates the improper control of surface runoff. The condition is not severe at present. The riprap missing on the upstream slope presents an erosion hazard. However, because of the core-wall protruding above the embankment, this condition is not of special concern. The condition of the core-wall is evaluated with the spillway.

(3) Appurtenant Structures. The concrete on the spillway weir was specifically added to improve its stability. Further deterioration could have significant effect on the stability. The deterioration of the concrete at the spillway and core-wall was first noted in 1921, during one of the periodic inspections by the Commonwealth, only 5 years after it was placed. Although the spillway concrete is subject to scour, the core-wall concrete is not. The deterioration of the core-wall, which is only exposed to the weather, is indicative of poor concrete mix design. The same concrete mix was probably used in the spillway. The seepage observed in the spillway channel is not excessive. It is flowing from the bedrock. The deteriorated mortar at the masonry gravity training wall prevents the wall from acting as a watertight structure. As the deterioration is in the upper part of the wall, it is not of major concern. Surface runoff may have washed some soil through the dry masonry wall near the toe of the embankment. As this wall is low and beyond the embankment, the condition is only of minor concern.

b. Design and Construction Data. No record of design data or stability analysis for the embankment was available for review. Analysis of the embankment stability is beyond the scope of this study. Also,

sufficient data on the engineering properties of the embankment material would have to be acquired before the analysis could be performed. No evidence of stability problems presently threatening the embankment were observed.

An analysis of stability for the spillway both in its present condition and in its pre-1916 condition are available for review. In the 1914 Report by the Pennsylvania Water Supply Commission, an analysis of the spillway indicated that the resultant was almost at the toe. A more complete history is given in Section 1.2g. The spillway was modified in 1916 to improve the stability. The results of the analysis of the modified section is shown on Plate 5.

For this study, a stability analysis was performed. The stability of the spillway section was analyzed. Only the highest section was considered and the stability was checked at its base. It was assumed that: headwater was at the top of the dam, tailwater was 15 feet above the toe, full hydrostatic head and at-rest earth pressure was on the upstream face, and uplift was varying from full tailwater at the toe to full tailwater plus two-thirds the difference between headwater and tailwater at the heel. For this loading condition, the resultant is about 5.4 feet inside the toe, but outside the middle third. The toe pressure and factor of safety against sliding are adequate. Although OCE guideline states that the resultant should be within the middle third, the location of the resultant is not deemed to be a significant deviation from the guideline, since the toe pressure is well below the allowable.

c. Operating Records. There are no formal records of operation. No evidence of instability on any feature of the dam has been noted.

d. Postconstruction Changes. As noted herein, there is sufficient information available on all modifications made to No. 5 Dam, such that its stability can be assessed.

e. Seismic Stability No. 5 Dam is located in Seismic Zone 1. Normally it can be considered that if a dam in this zone has adequate factors of safety under static loading conditions, it can be assumed safe for any expected earthquake loading. However, since there are no formal static stability analyses, and since there is the potential of earthquake forces moving or cracking the masonry core-wall, the theoretical seismic stability of No. 5 Dam cannot be assessed.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND

PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety.

(1) Based on the visual inspection, available records, calculations, and past operational performance, No. 5 Dam is judged to be in fair condition. The existing spillway will pass 29 percent of the PMF without overtopping of the dam. Failure of the dam would cause an increased hazard to loss of life downstream. The spillway is rated as seriously inadequate. According to criteria established for these studies, the dam must be rated as unsafe, nonemergency, because the spillway capacity is seriously inadequate.

(2) There is no evidence of serious stability problems at the embankment. The gravity spillway has a resultant outside the middle third but within the base for the maximum loading condition. This is not considered to be a significant deviation from the OCE guidelines, since the toe pressure is well below the allowable.

(3) The visual inspection revealed some deficiencies, which are summarized below for the various features.

Feature and Location	Observed Deficiency
Embankment	
Top	Deteriorated concrete core-wall.
Right abutment	Eroded surface drainage swale.
Upstream slope	Riprap missing.
Downstream slope	Trail bike ruts.
Spillway:	
Weir	Deteriorated concrete and mortar

Feature and Location	Observed Deficiency (Cont'd)
Training wall	Deteriorated mortar.
Channel	Seepage from bedrock.
Dry masonry wall	Depression behind wall.
Outlet Works:	
Intake approach walls	Capstones dislodged.
Intake structure	Interior vandalized.

b. Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented immediately.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations by the Owner will be required.

7.2 Recommendations and Remedial Measures.

a. The following measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform additional studies to more accurately ascertain the spillway capacity required for No. 5 Dam, as well as the nature and extent of the mitigation measures required to make the spillway hydraulically adequate. Take remedial measures as required. The studies should be performed by a professional engineer experienced in the design and construction of dams.

(2) Repair the concrete at the spillway weir and the core-wall.

(3) Repair the vandalized interior of the intake structure so that adequate access to the upstream closure valves is available. Ensure that the valves are operational.

(4) Repair the mortar at the spillway and at the masonry gravity training wall.

(5) Replace the dislodged capstones at the outlet works approach wall.

(6) Repair the riprap on the upstream slope of the embankment.

(7) Provide a proper surface drainage path near the right abutment.

(8) Monitor, by any suitable means, the seepage at the spillway channel. If significant changes are noted, take appropriate action.

(9) Monitor, by any suitable means, the depression behind the dry masonry wall. If changes are noted, take appropriate action.

b. In addition, it is recommended that the Owner modify his operational procedures as follows:

(1) Develop a detailed emergency operation and warning system for No. 5 Dam. A similar system has already been recommended in other reports for Lake Scranton and Williams Bridge Dams, which are located upstream.

(2) Provide round-the-clock surveillance of No. 5 Dam during periods of unusually heavy rains.

(3) Develop impediments to trail bike use on the embankment and improve security at the damsite.

(4) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

SUSQUEHANNA RIVER BASIN

STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

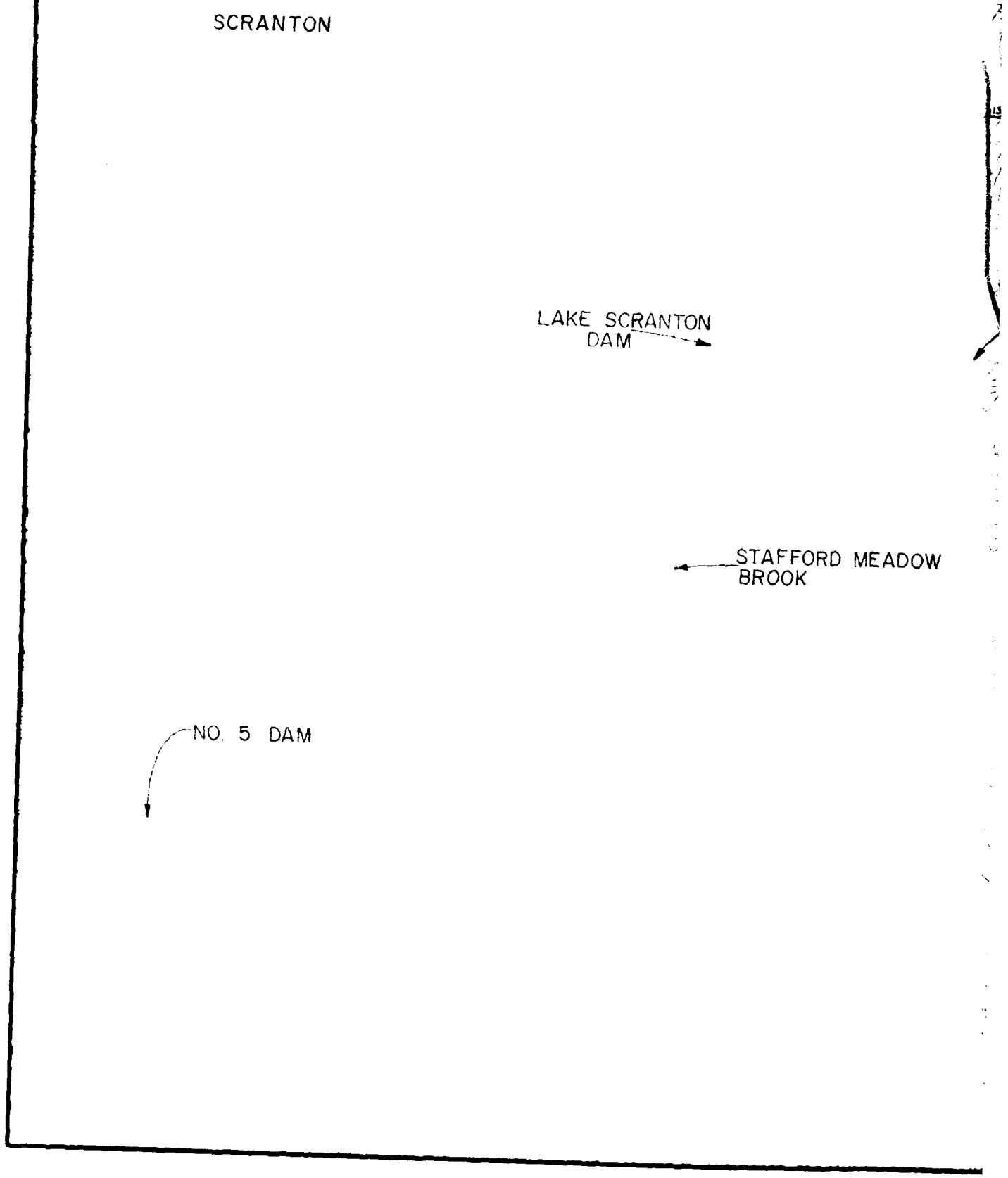
PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

PLATES


SCRANTON
LAKE SCRANTON
DAM
STAFFORD MEADOW
BROOK
NO. 5 DAM

WILLIAMS BRIDGE DAM

2000 0 2000

SCALE: 1 IN. = 2000 FT.

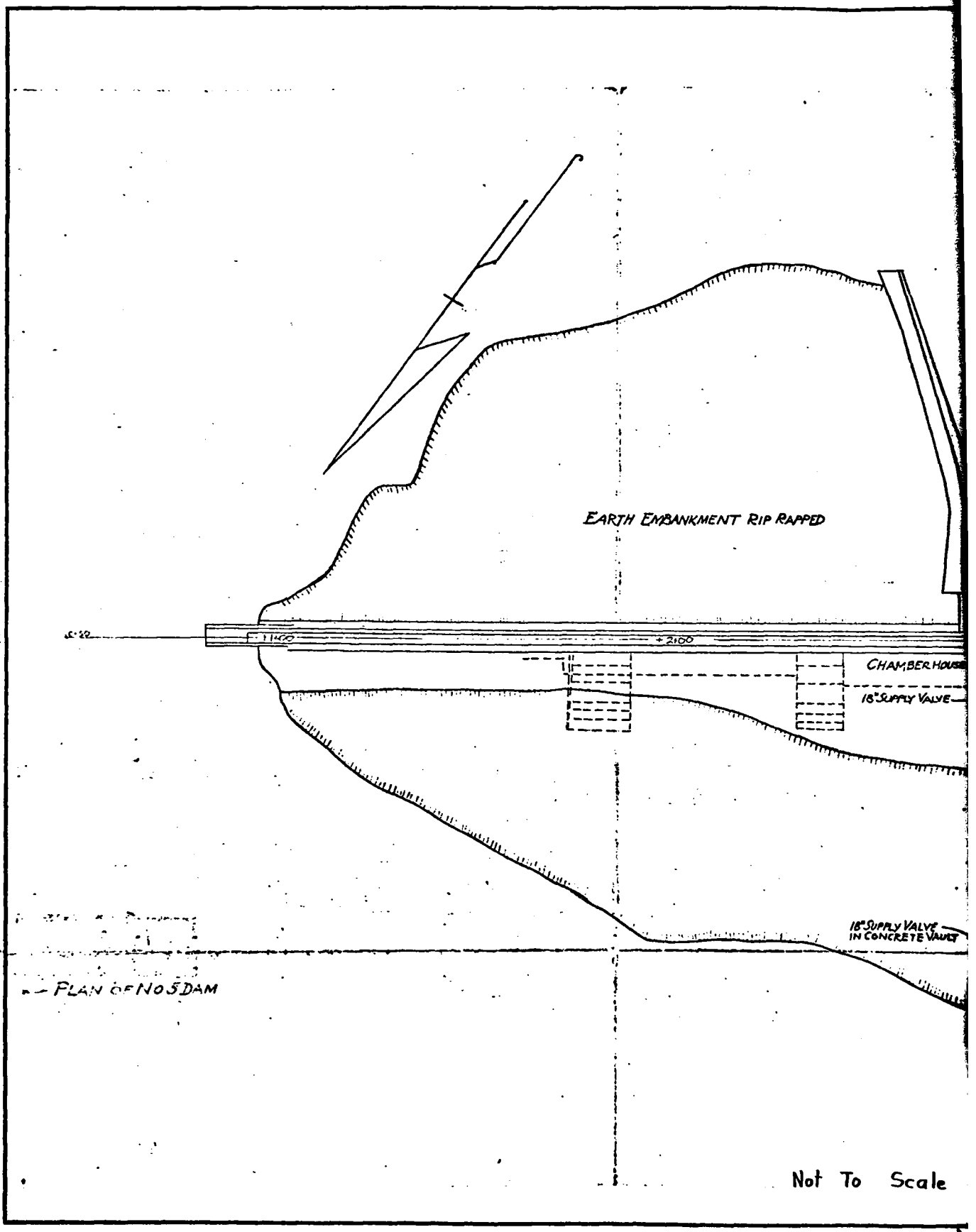
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NO. 5 DAM

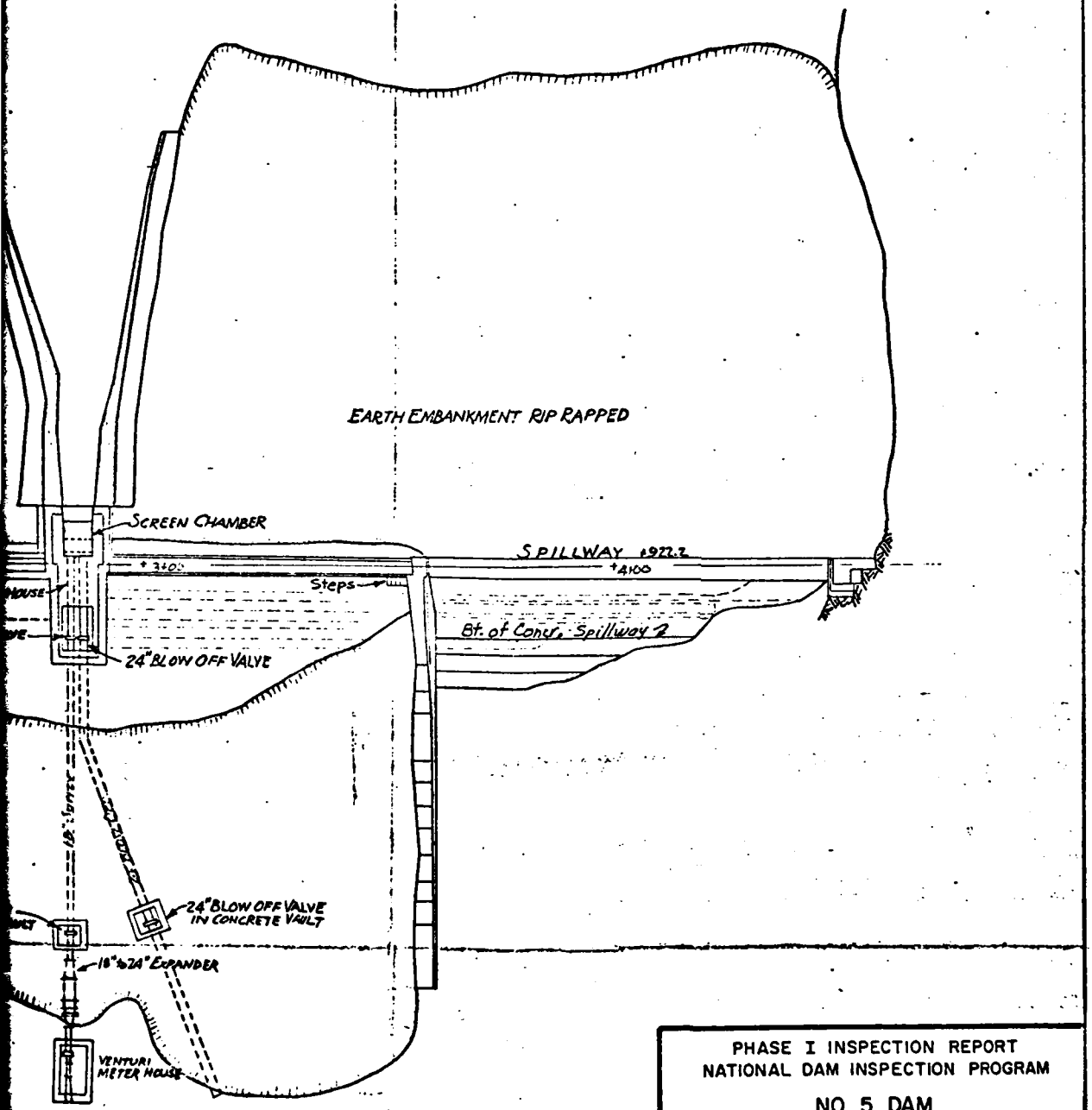
PENNSYLVANIA GAS AND WATER COMPANY

LOCATION MAP

APRIL 1979 PLATE 1


EARTH EMBANKMENT RIP RAPPED
+1400
+2100
CHAMBER HOUSE
18" SUPPLY VALVE
18" SUPPLY VALVE IN CONCRETE VAULT
PLAN OF NO 5 DAM
Not To Scale

S.G & W Co.
DISTRIBUTING RESERVOIRS
Sheet



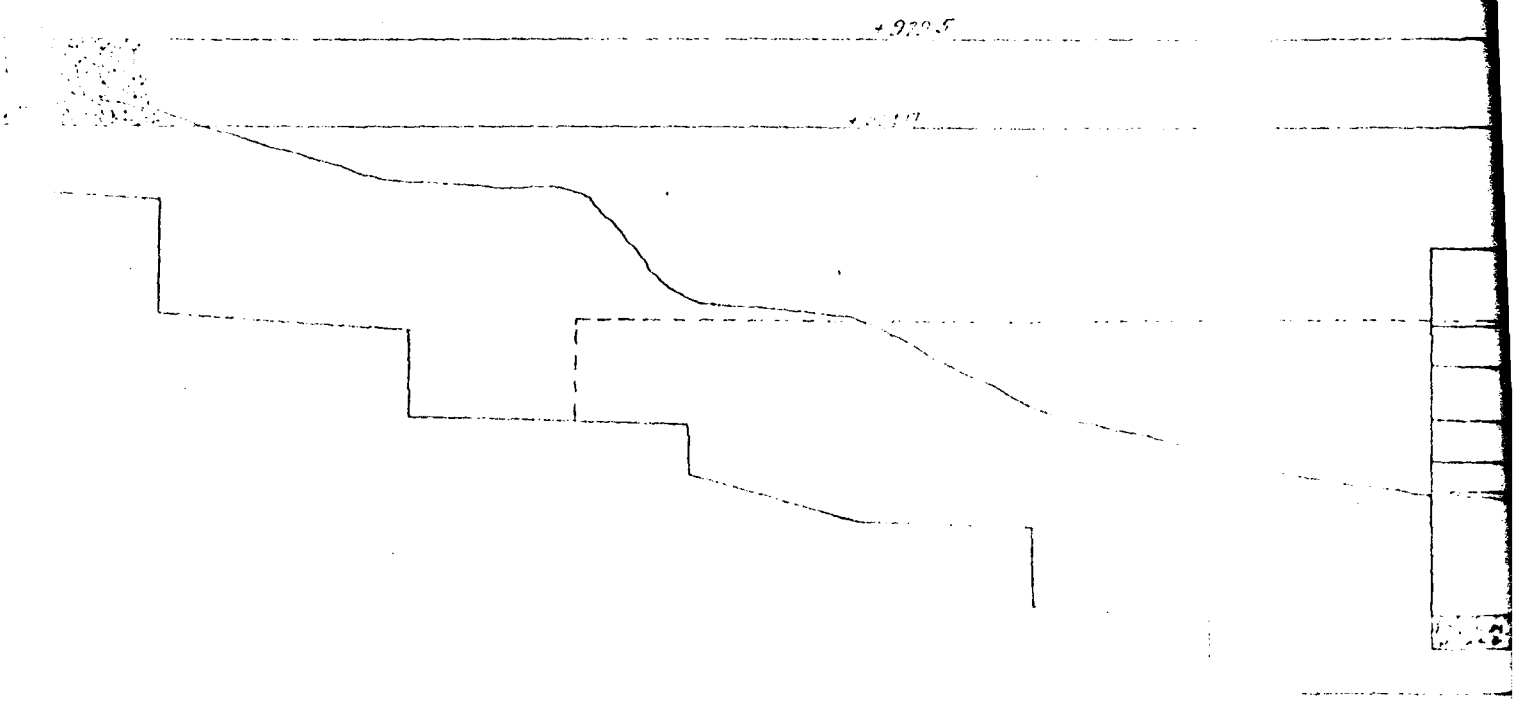
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NO. 5 DAM

PENNSYLVANIA GAS AND WATER COMPANY

PLAN

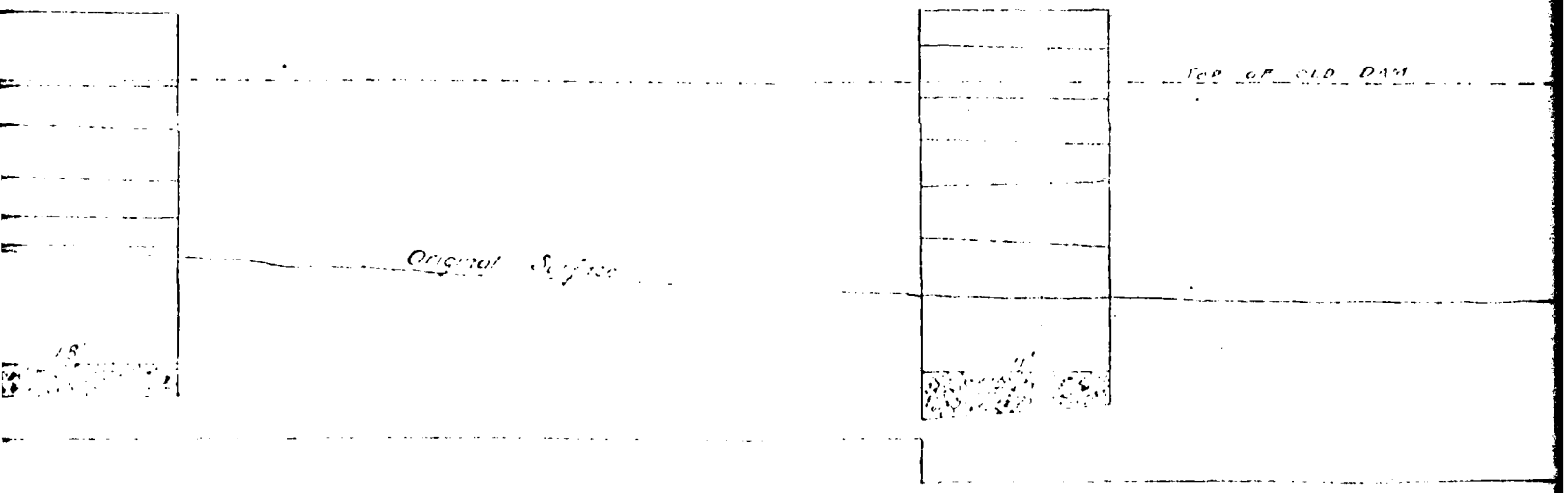
1979 PLATE 2



2.00

CONCRETE

MASONRY

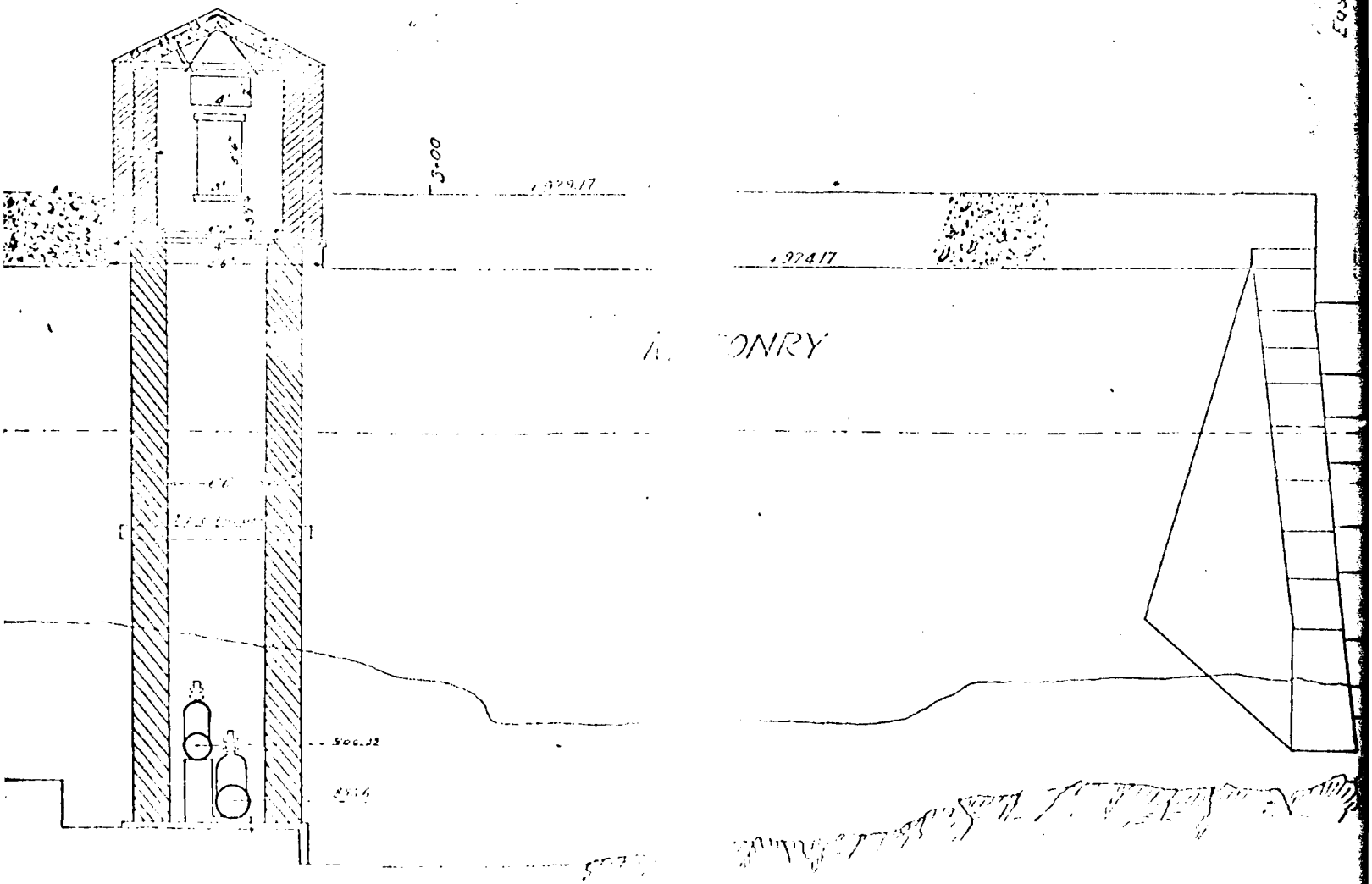


RESERVOIR N

LONGITUDINAL SECTION O

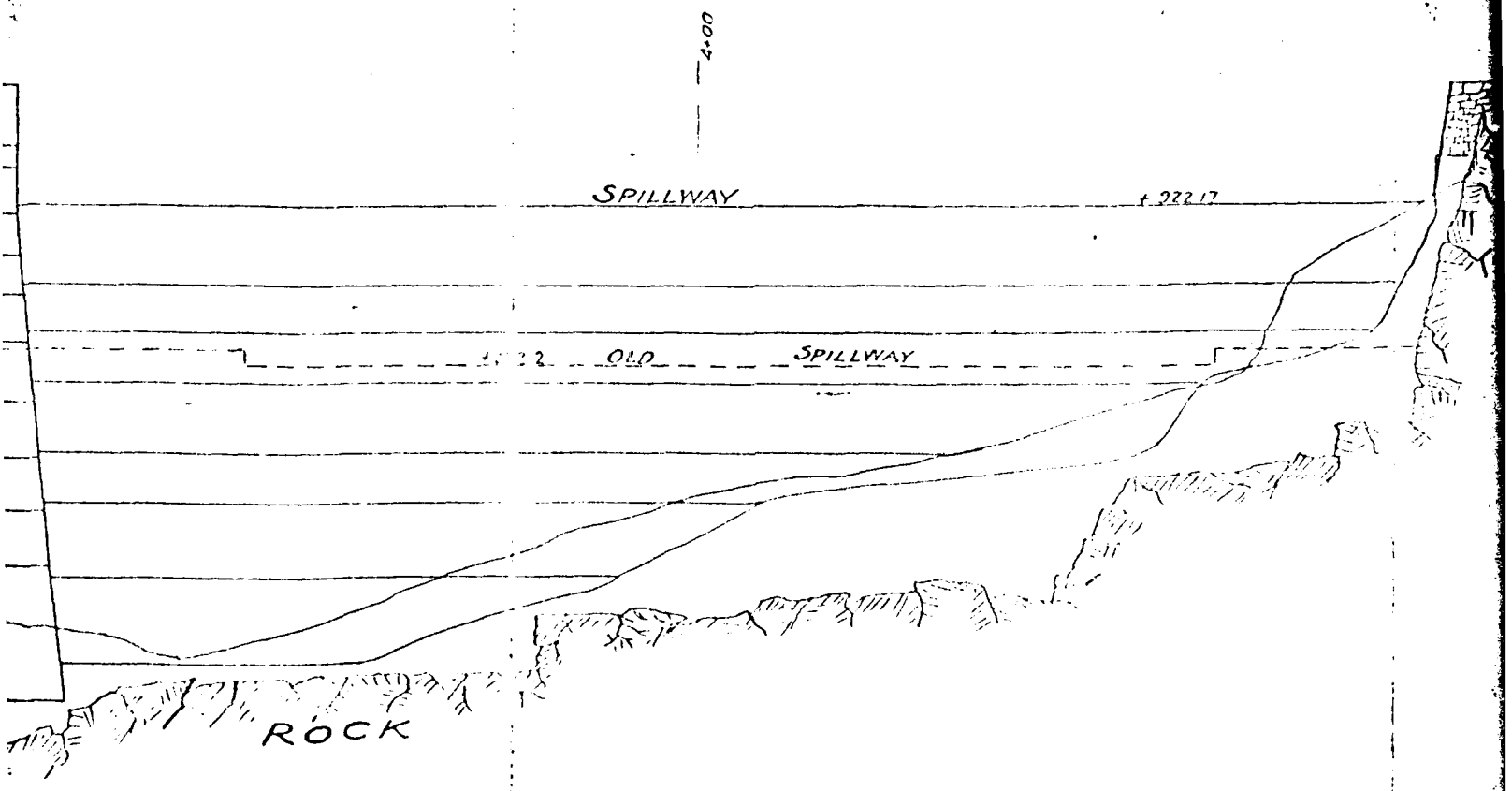
Scale 1 Inch = 10 Ft.

East End Spillway



NO. 5
OF MAIN DAM

S. G. & W. Co
DISTRIBUTING RESER
Sheet# 15/



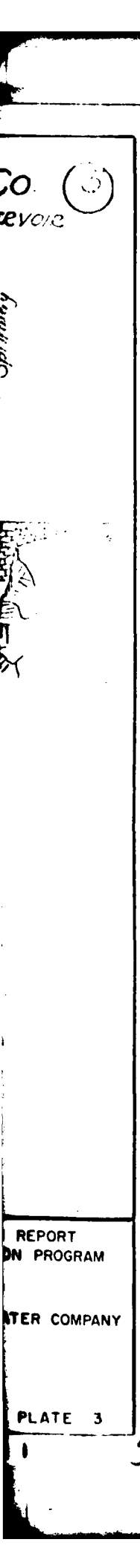
PHASE I INSPECTION
NATIONAL DAM INSPECTION

NO. 5 DAM

PENNSYLVANIA GAS AND WATE

PROFILE

APRIL 1979


Co.
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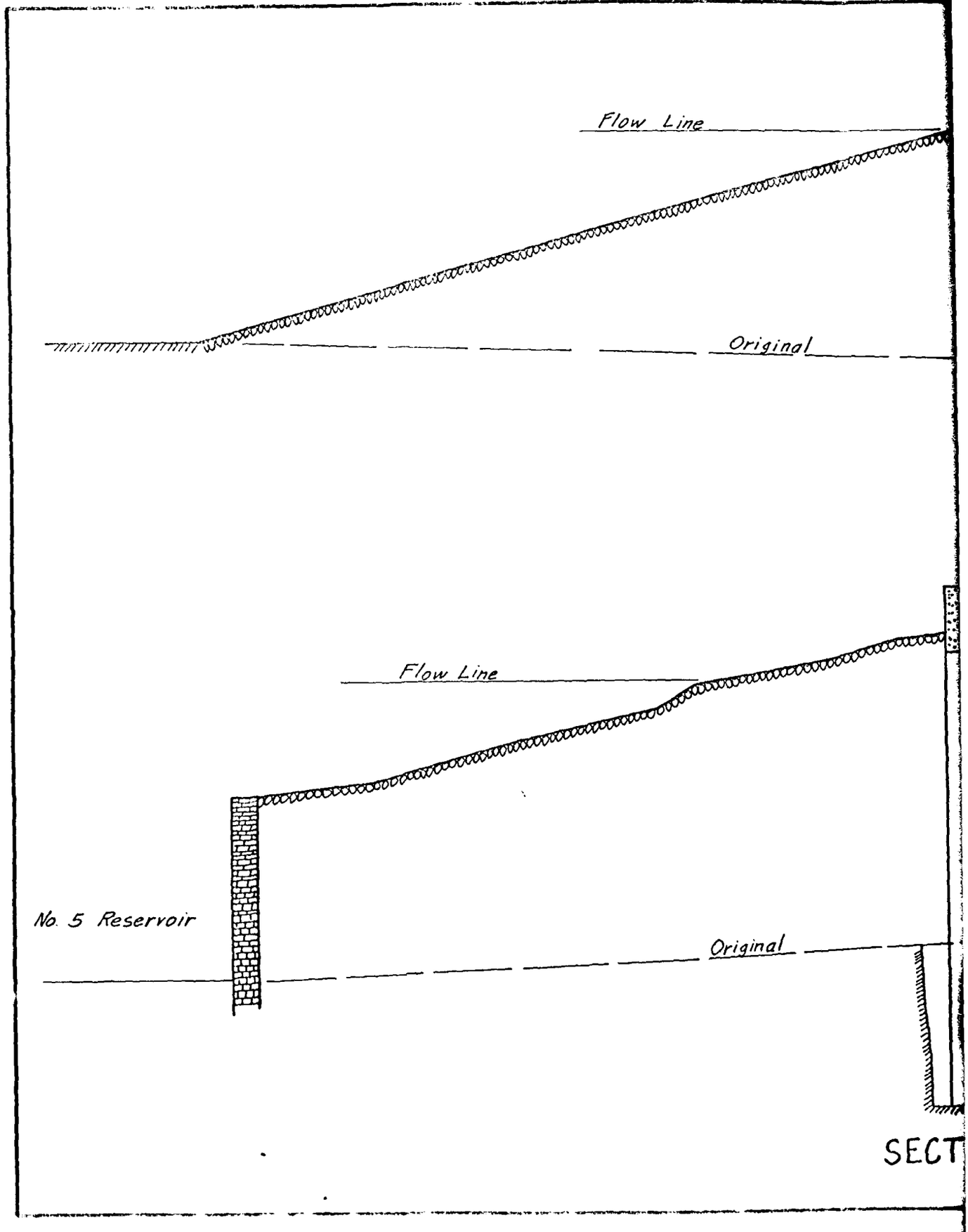
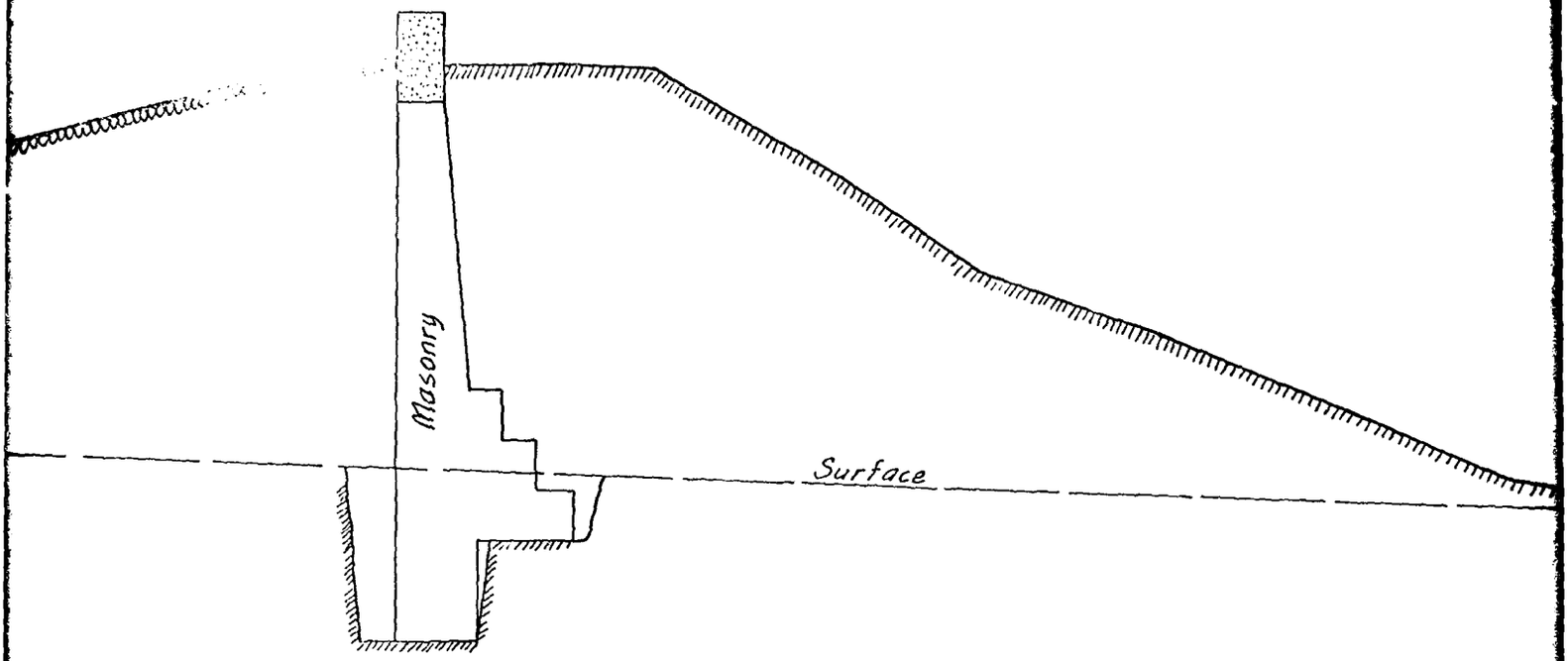
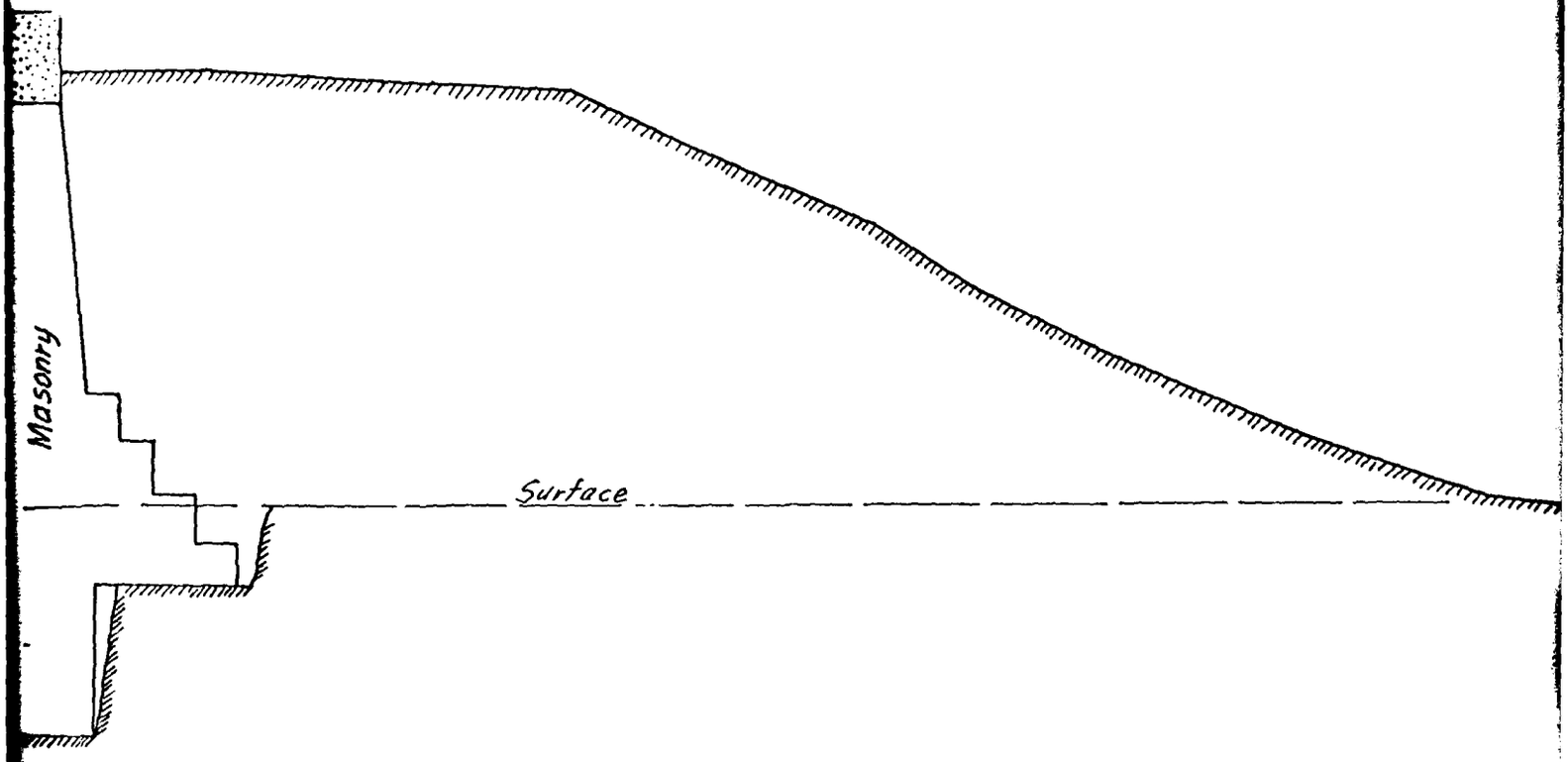
REPORT
ON PROGRAM
ATER COMPANY
PLATE 3

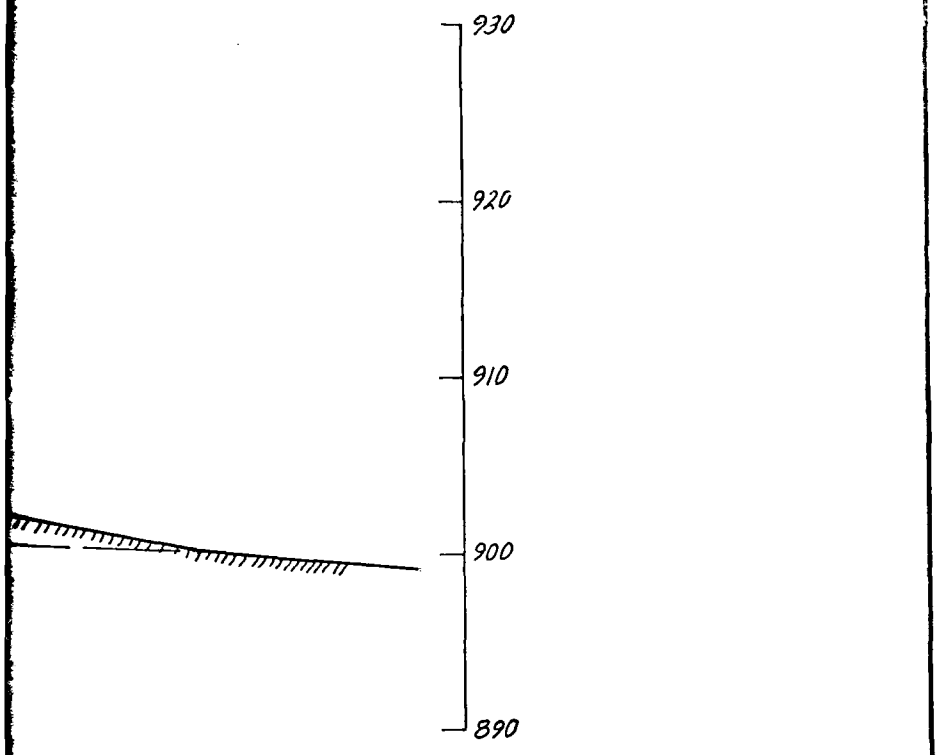

Flow Line
Original
Flow Line
No. 5 Reservoir
Original
SECT

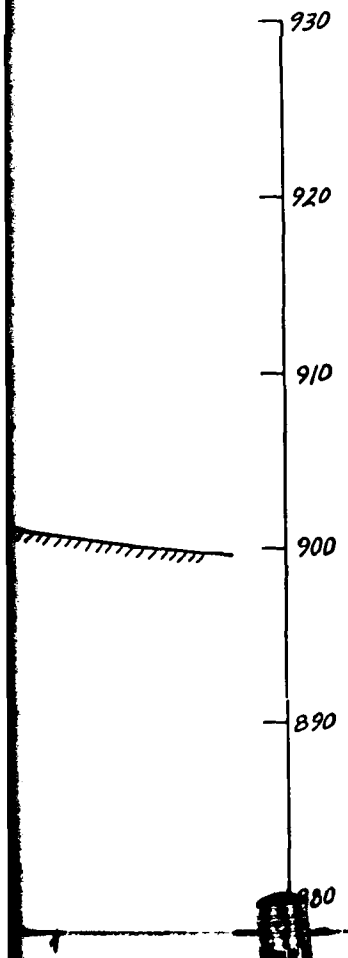


SECTION 2+00



ION 2+72





NOTE:
This drawing was traced from owner's original drawing.

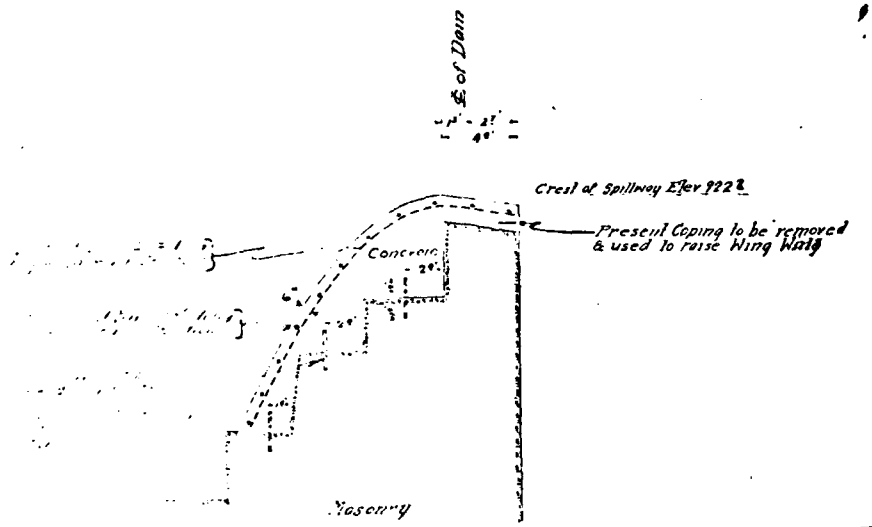
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NO. 5 DAM

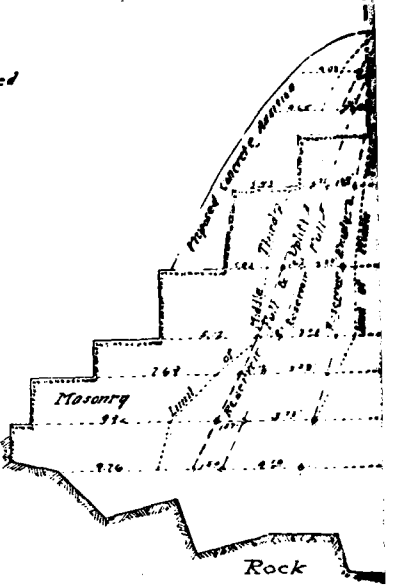
PENNSYLVANIA GAS AND WATER COMPANY

SECTIONS

APRIL 1979 PLATE 4



Part Section
showing
Reinforcement in Proposed Addition to Spillway
Scale 1" 4'

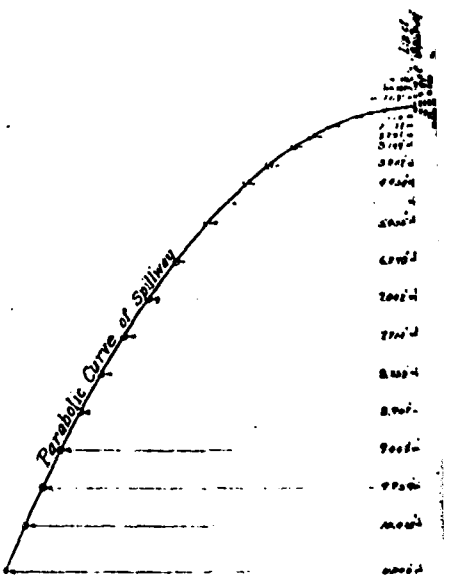


Section showing
Lines of Pressure, Reservoir Full
Scale 1"

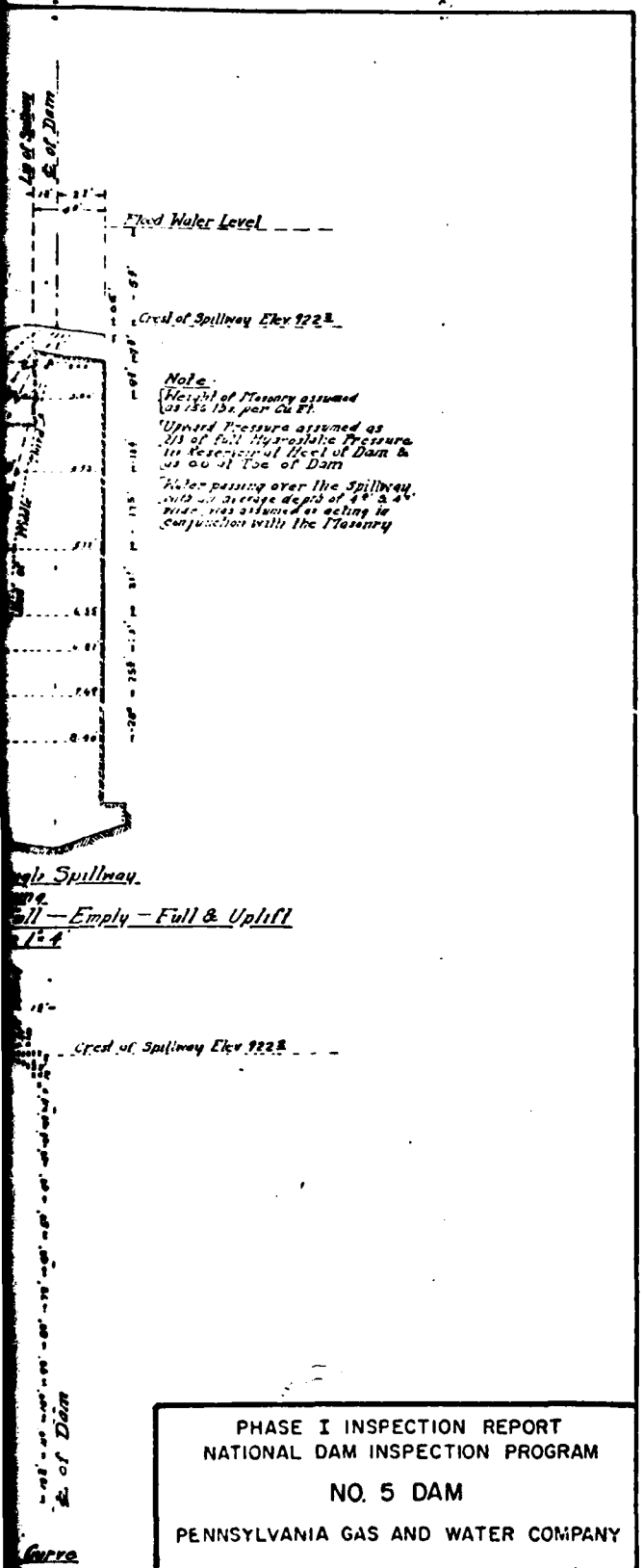
NO 5 DAM
ON STAFFORD MEADOW BROOK
SECTIONS
showing.
PROPOSED METHOD OF STRENGTHENING SPILLWAY
S. G. & W. Co.

Scales indicated Scranton Pa March 27, 1916

H. E. Wright
Chief Engineer



Parabolic Spillway
Scale 1" 2'



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NO. 5 DAM

PENNSYLVANIA GAS AND WATER COMPANY

SPILLWAY SECTIONS

APRIL 1979 2 PLATE 5

SUSQUEHANNA RIVER BASIN

STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: No. 5

NDI ID NO.: PA-00375 DER ID NO.: 35-22

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	DRAWINGS PREPARED FOR VARIOUS MODIFICATIONS - SEE PLATES 2-5.
REGIONAL VICINITY MAP	SEE PLATE 1
CONSTRUCTION HISTORY	BUILT 1887-1888 ENLARGED 1893 SPILLWAY STRENGTHENED - 1916
TYPICAL SECTIONS OF DAM	SEE PLATE 4
OUTLETS: Plan Details Constraints Discharge Ratings	AVAILABLE

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	NONE
DESIGN REPORTS	NONE
GEOLOGY REPORTS	1914 PA. WATER SUPPLY COMMISSION REPORTS.
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	ANALYSES FOR HYDRAULICS AND HYDROLOGY AND SPILLWAY STABILITY AVAILABLE.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	NONE
POSTCONSTRUCTION SURVEYS OF DAM	SEE "AS-BUILT DRAWINGS"

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	LOWER DOWNSTREAM EMBANKMENT FROM RESERVOIR. UPPER DOWNSTREAM EMBANKMENT FROM HILLSIDE.
MONITORING SYSTEMS	NONE
MODIFICATIONS	SEE CONSTRUCTION HISTORY
HIGH POOL RECORDS	NONE
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	SUPPLEMENTARY REPORT BY WATER SUPPLY COMMISSION NOT AVAILABLE.
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	NONE

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	NOT AVAILABLE
SPILLWAY: Plan Sections Details	SEE PLATE 5
OPERATING EQUIPMENT: Plans Details	SEE PLATE 2
PREVIOUS INSPECTIONS Dates Deficiencies	1921 - NEW CONCRETE ON SPILLWAY DETERIORATING. 1925 - PER 1921 AND SLIGHT SEEPAGE AT LEFT END OF SPILLWAY 1928 - PER 1921 1932 - PER 1925 1941 - PER 1925, DISINTEGRATION IS MORE SEVERE. CORE WALL SHOWS SIGNS OF DETERIORATION.
	1943 - PER 1941 AND SLIGHT DETERIORATION AT RIGHT TRAINING WALL. 1945 - PER 1943. 1953 - NO DEFICIENCIES (WATER FLOWING OVER SPILLWAY). 1957 - "SLIGHT LEAKAGE" - "DOWNSTREAM FACE DETERIORATED POOL LEVEL NOT NOTED.

A-4

SUSQUEHANNA RIVER BASIN

STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: No. 5 County: Lackawanna State: Pennsylvania

NDI ID No.: PA - 00375 DER ID No.: 35-22

Type of Dam: Earthfill with core wall Hazard Category: High

Date(s) Inspection: 8 November 1978 Weather: Overcast Temperature: 50°F

Soil conditions: moist

Pool Elevation at Time of Inspection: 922.3 msl/Tailwater at Time of Inspection: 895.2 msl

Inspection Personnel:

J. Crouse (GFCC)

G. Smith (GFCC)

B. Glocknar (PGW)

A. Whitman (GFCC) Recorder

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NONE	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	TRAIL BIKE RUTS IN DOWNSTREAM EMBANKMENT. CAR RUTS ON TOP.	OLD WINGWALL ENTIRELY WITHIN EMBANKMENT IS DETERIORATED THIS IS OF NO SIGNIFICANCE.
CREST ALIGNMENT: Vertical Horizontal	SEE SURVEY DATA	
RIPRAP FAILURES	RIPRAP IS WASHED OUT LEFT OF THE INTAKE STRUCTURE AND FOR 20' TO THE RIGHT.	

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	SURFACE DRAINAGE SWALE AT RIGHT ABUTMENT	
ANY NOTICEABLE SEEPAGE	NONE	
STAFF GAGE AND RECORDER	NONE	
DRAINS	NONE	
CORE-WALL	70% SPALLED AND PEELING SEE SURVEY DATA PROFILE.	

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	CIP- 24" DIA.	
INTAKE STRUCTURE	INSIDE IS VANDALIZED AND HAZARDOUS. CAPSTONES ON APPROACH WALL ARE DISLODGED.	DOOR SILL AND WINDOW LEDGES HAVE BEEN RAISED.
OUTLET STRUCTURE	NO DEFICIENCIES	
OUTLET CHANNEL	NO DEFICIENCIES	
EMERGENCY GATE	OPENED 5% by 2 MEN IN 15 MINUTES	NO DEFICIENCIES

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR UPPER PART - CONCRETE LOWER PART - MASONRY	CONCRETE VERY DETERIORATED REBAR EXPOSED. MASONRY HAS MINOR MORTAR DETERIORATION.	
APPROACH CHANNEL	RESERVOIR	
DISCHARGE CHANNEL	MASONRY WINGWALL - DETERIORATED MORTAR ALONG UPPER 3'. LEACHING OBSERVED BELOW. DRY MASONRY WALL - SOIL BEHIND WALL DEPRESSED	2 MINOR SEEPS 4' ABOVE BOTTOM OF CHANNEL.
BRIDGE AND PIERS	NONE	

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE	
OBSERVATION WELLS	NONE IN A USEABLE STATE.	
WEIRS	NONE	
PIEZOMETERS	NONE	
OTHER	NONE	

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	STEEP	
SEDIMENTATION	NO PROBLEMS REPORTED OR OBSERVED.	
WATERSHED DESCRIPTION	BETWEEN LAKE SCRANTON AND NO.5 DAM – WOODED, UNINHABITED, VERY STEEP.	LAKE SCRANTON AND WILLIAMS BRIDGE DAM ARE UPSTREAM. THEIR WATERSHEDS HAVE SOME RURAL DEVELOPMENT.

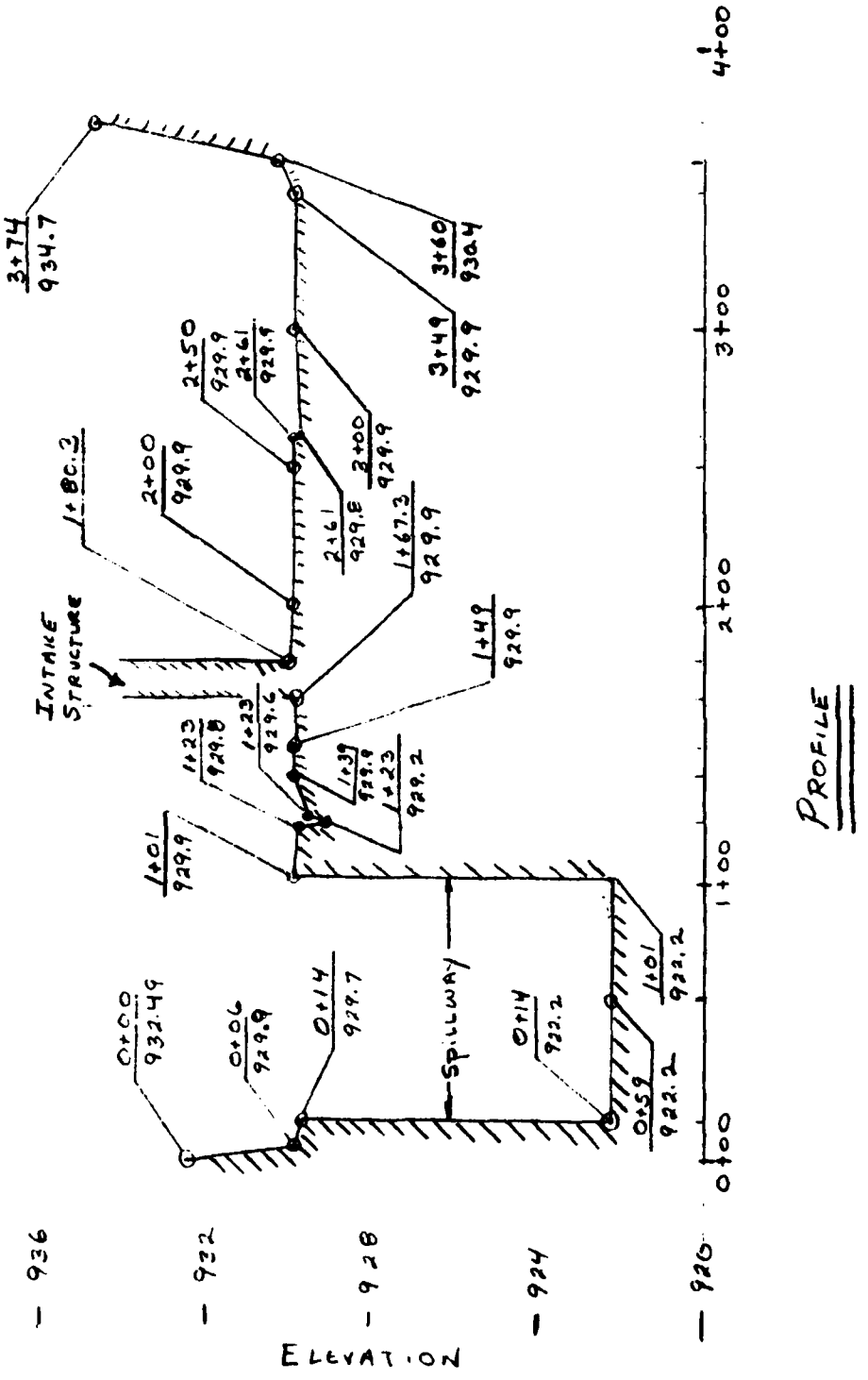
DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	NO DEFICIENCIES	
SLOPES	RELATIVELY STEEP	
APPROXIMATE NUMBER OF HOMES AND POPULATION	SCRANTON - MAJOR URBAN - STREAM PASSES THROUGH MANY SMALL CULVERTS.	

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT No. 5 FILE NO.
SHEET NO. OF SHEETS
FOR
COMPUTED BY DATE CHECKED BY DATE



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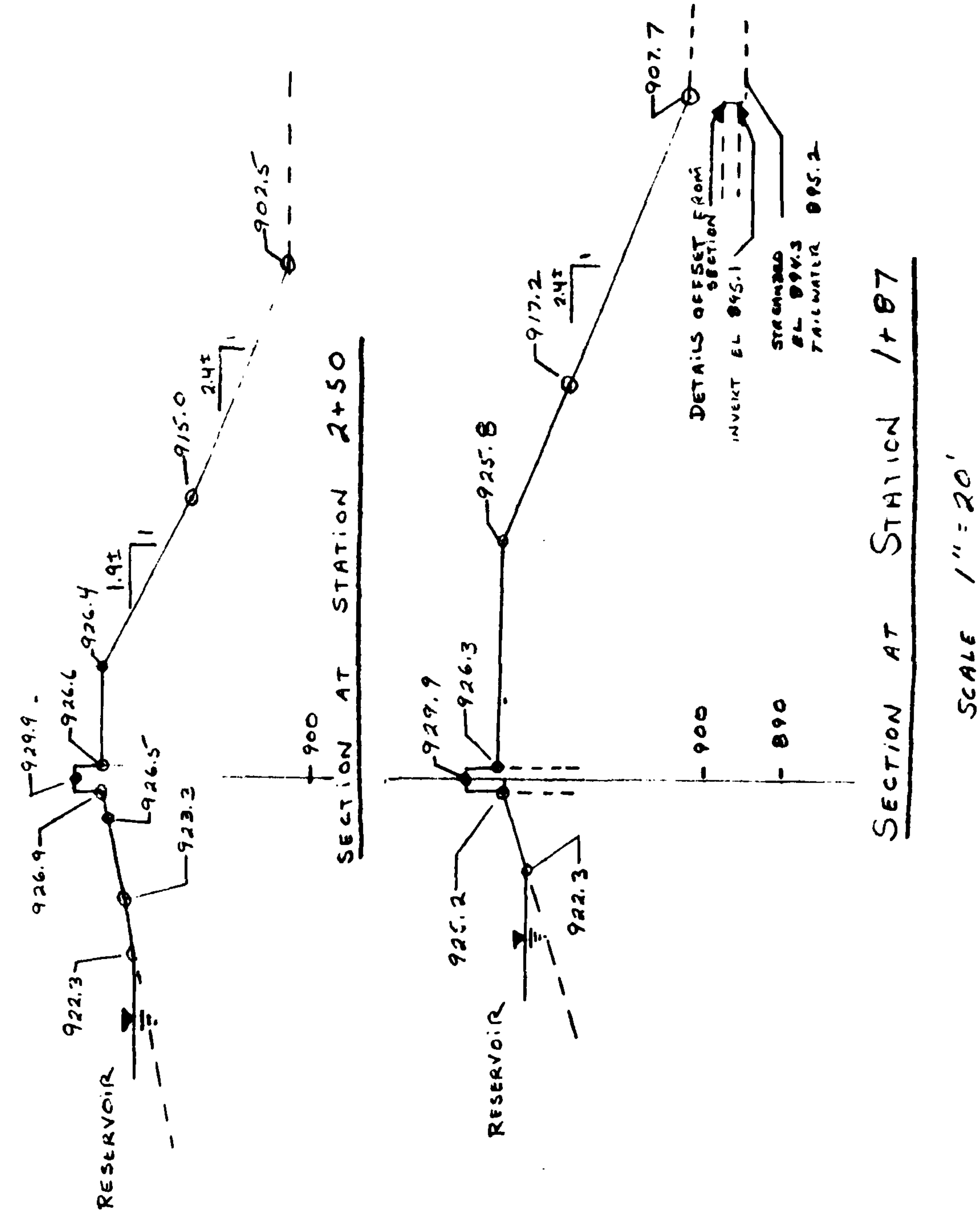
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT ______ FILE NO. ______
______ SHEET NO. ___ OF ___ SHEETS
FOR ______
COMPUTED BY ______ DATE ______ CHECKED BY ______ DATE ______



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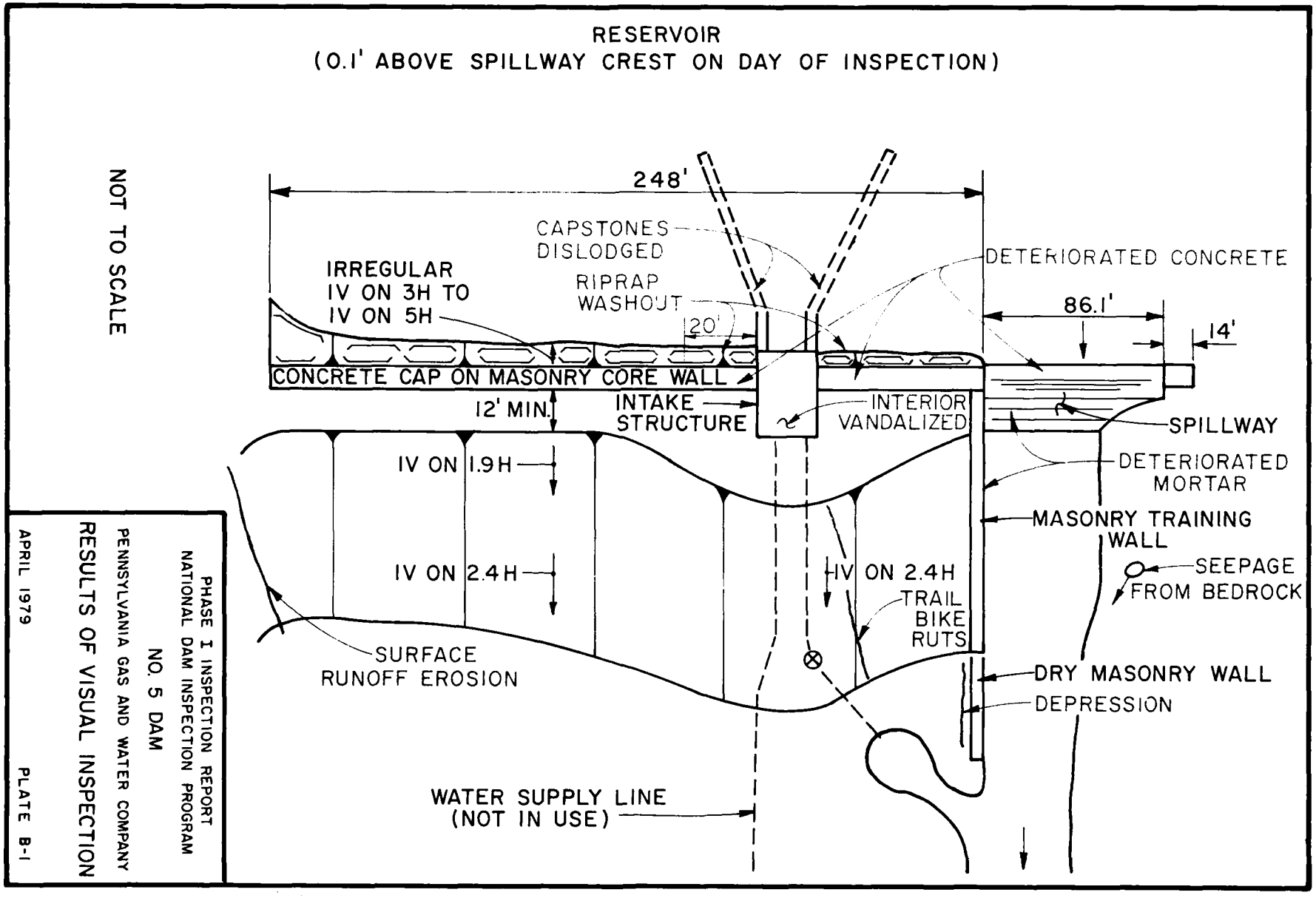

RESERVOIR
(0.1' ABOVE SPILLWAY CREST ON DAY OF INSPECTION)
NOT TO SCALE
248'
CAPSTONES DISLODGED
RIPRAP WASHOUT
IRREGULAR IV ON 3H TO IV ON 5H
20'
DETERIORATED CONCRETE
86.1'
14'
CONCRETE CAP ON MASONRY CORE WALL
12' MIN.
INTAKE STRUCTURE
INTERIOR VANDALIZED
SPILLWAY
IV ON 1.9H
DETERIORATED MORTAR
MASONRY TRAINING WALL
IV ON 2.4H
IV ON 2.4H
SEEPAGE FROM BEDROCK
TRAIL BIKE RUTS
SURFACE RUNOFF EROSION
DRY MASONRY WALL
DEPRESSION
WATER SUPPLY LINE (NOT IN USE)
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NO. 5 DAM
PENNSYLVANIA GAS AND WATER COMPANY
RESULTS OF VISUAL INSPECTION
APRIL 1979
PLATE B-1

SUSQUEHANNA RIVER BASIN

STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

APPENDIX C

HYDROLOGY AND HYDRAULICS

APPENDIX C

HYDROLOGY AND HYDRAULICS

In the recommended Guidelines for Safety Inspection of Dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended Spillway Design Flood (SDF) for the size (small, intermediate, or large) and hazard potential (low, significant, or high) classification of a dam is selected in accordance with the criteria. The SDF for those dams in the high hazard category varies between one-half of the Probable Maximum Flood (PMF) and the PMF. If the dam and spillway are not capable of passing the SDF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, or if the dam is not in the high hazard category, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

APPENDIX C

SUSQUEHANNA River Basin

Name of Stream: STAFFORD MEADOW BROOK

Name of Dam: NO. 5

NDS ID No.: PA-00375

DER ID No.: 35-22

Latitude: N 41° 21' 40" Longitude: W 75° 40' 15"

Top of Dam (~~low spot~~ design) Elevation: 929.5

Streambed Elevation: 894.3 Height of Dam: 35 ft

Reservoir Storage at Top of Dam Elevation: 927 acre-ft

Size Category: SMALL

Hazard Category: HIGH (see Section 5)

Spillway Design Flood: PMF - MANY PEOPLE DOWNSTREAM

UPSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
WILLIAMS BRIDGE	UPSTREAM LK SCRANTON	54	1,276	SERIOUSLY INADEQUATE SPILLWAY
LAKE SCRANTON	2.3	60	8,397	SERIOUSLY INADEQUATE SPILLWAY

DOWNSTREAM DAMS

NONE				

SUSQUEHANNA River Basin

Name of Stream: STAFFORD MEADOW BROOK

Name of Dam: NO. 5

NDS ID No.: PA-00375

DER ID No.: 35-22

Latitude: N 41° 21' 40" Longitude: W 75° 40' 15"

DETERMINATION OF PMF RAINFALL

For Area A

which consists of Subareas	A1	of 5.7 sq. mile
	A2	1.5
	A3	4.8

Total Drainage Area 12.0 sq. mile

PMF Rainfall Index = 22.15 in., 24 hr., 200 sq. mile

	Hydromet. 40 (Susquehanna Basin)	Hydromet. 33 (Other Basins)
Zone	N/A	
Geographic Adjustment Factor	98%	1.0
Revised Index Rainfall	21.7 INCHES	

RAINFALL DISTRIBUTION (percent)

Time	Percent
6 hours	116
12 hours	125
24 hours	134
48 hours	141
72 hours	143
96 hours	N/A

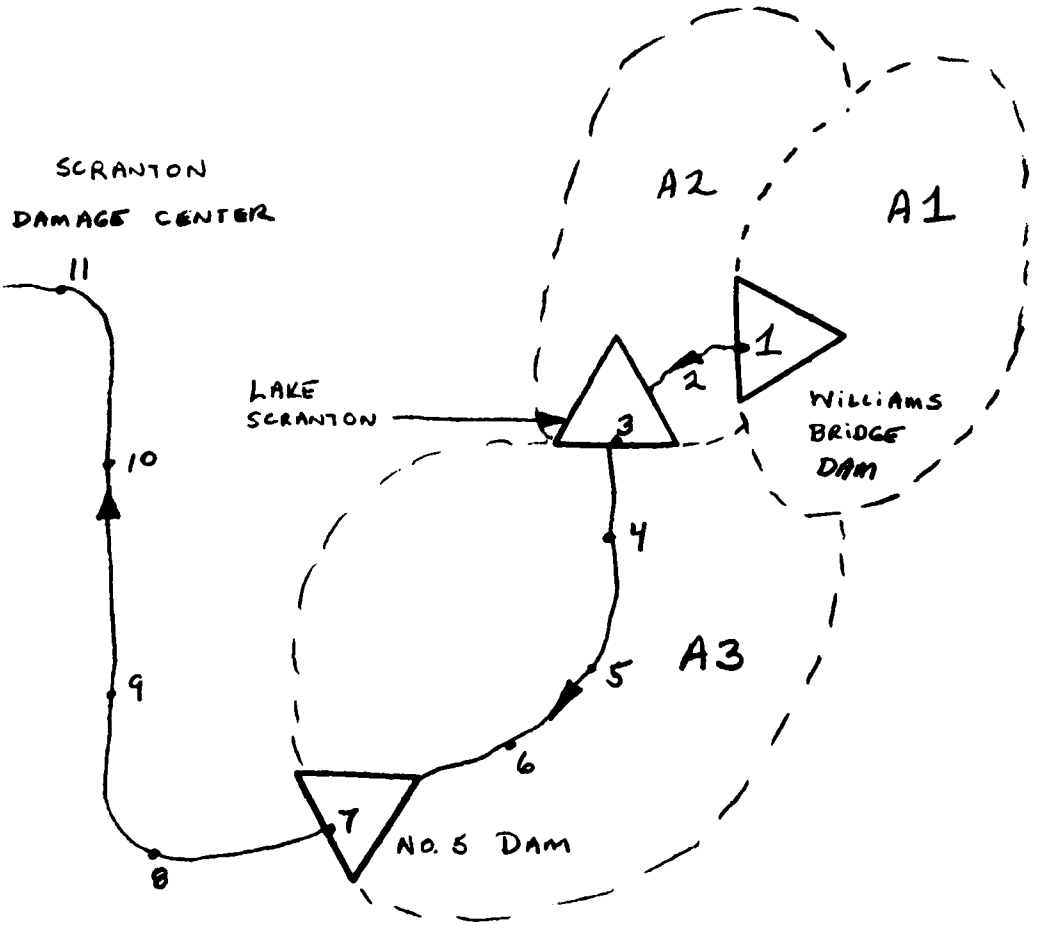
GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____

_____ SHEET NO. _____ OF _____ SHEETS

FOR _____

COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____



SKETCH
OF SYSTEM

SEE PLATE C-1
FOR EXACT LOCATIONS

0319

Data for Dam at Outlet of Subarea A1
(see Sketch on Sheet C-4)

Name of Dam: WILLIAMS BRIDGE Sheet 1 of __

Height: 54 FEET (existing) OUTLET WORKS 130 CFS MAX - NEGLECTED

Spillway Data: FROM PHASE I REPORT	Existing Conditions	Design Conditions
Top of Dam Elevation	1366.2	1366.2
Spillway Crest Elevation	1360.6	1360.6
Spillway Head Available (ft)		5.6
Type Spillway		BROAD CRESTED WEIR
"C" Value - Spillway		3.15
Crest Length - Spillway (ft)		56.3
Spillway Peak Discharge (cfs)		2350
Auxiliary Spillway Crest Elevation	1361.6	1361.6
Auxiliary Spillway Head Available (ft)		4.6
Type Auxiliary Spillway		BROAD CRESTED WEIR
"C" Value - Auxiliary Spillway		3.15
Crest Length - Auxiliary Spillway (ft)		103.3
Auxiliary Spillway Peak Discharge (cfs)		3210
Combined Spillway Discharge (cfs)		5560

Spillway Rating Curve: COMPUTED FROM ABOVE

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
1360.6	0	0	0
1361.6	177	0	177
1362.6	502	325	827
1364.6	1,419	1,691	3110
1366.2	2,350	3,210	5560
1368.6	4,013	6,026	10,039

Data for Dam at Outlet of Subarea A1

Name of Dam: WILLIAMS BRIDGE Sheet 3 of __

Storage Data:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
1288.5 = ELEVO*	0	0	0	
1360.6 = ELEV1	43 = A1	337	1034 = S1	
1366.2	44			
1380.0	76			
**				

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Top of Dam is 1 percent of watershed.

Remarks: _____

SUSQUEHANNA River Basin

Name of Stream: STAFFORD MEADOW BROOK

Name of Dam: NO.5

~~NDS ID No.~~: _____

~~DBR ID No.~~: _____

Latitude: N 41° 21' 40" Longitude: W 75° 40' 15"

Drainage Area: 12.0 sq. mile

Data for Subarea: A1 (see Sketch on Sheet C-4)

Name of Dam at Outlet of Subarea: WILLIAMS BRIDGE

Drainage Area of Subarea: 5.7 sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = 4.4 mile

L_{CA} = Length of Main Watercourse to the centroid = 1.5 mile

From NAB Data: AREA 11 PLATE E

Cp = 0.62

C_T = 1.50

$Tp = C_T \times (L \times L_{CA})^{0.3}$ = 2.64 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 8.6 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

Data for Dam at Outlet of Subarea A2
(see Sketch on Sheet C-4)

Name of Dam: LAKE SCRANTON Sheet 1 of ___

Height: 60 FEET (existing) OUTLET WORKS IGNORED FOR FLOODFLOWS

Spillway Data: FROM PHASE I REPORT	Existing Conditions	Design Conditions
Top of Dam Elevation	1286.1	1286.1
Spillway Crest Elevation	1282.8	1282.8
Spillway Head Available (ft)	3.3	3.3
Type Spillway	ROUNDED CREST	
"C" Value - Spillway	SEE NEXT SHEET	
Crest Length - Spillway (ft)	100	100
Spillway Peak Discharge (cfs)	2298	2298
Auxiliary Spillway Crest Elevation	1283.3	1283.3
Auxiliary Spillway Head Available (ft)	2.8	2.8
Type Auxiliary Spillway	11 ARCHES EACH 3.5' HIGH BY 17' LONG *	
"C" Value - Auxiliary Spillway	SEE NEXT SHEET	
Crest Length - Auxiliary Spillway (ft)		
Auxiliary Spillway Peak Discharge (cfs)	2215	2215
Combined Spillway Discharge (cfs)		

Spillway Rating Curve:

* PHASE I REPORT NOTES DIFFICULTY OF ESTIMATING CAPACITY
** VARIES SLIGHTLY FROM PHASE I REPORT

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Q Combined (cfs)
	SEE NEXT SHEETS		

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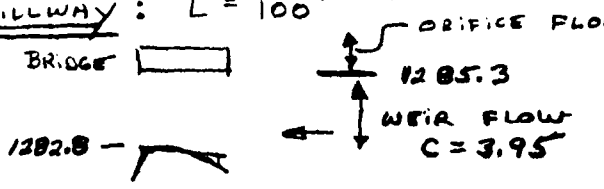
HARRISBURG, PA.

SUBJECT LAKE SCRANTON FILE NO.
SHEET NO. OF SHEETS
FOR MAIN SPILLWAY
COMPUTED BY DATE CHECKED BY DATE

DATA FROM PHASE I REPORT

MAIN SPILLWAY: L = 100'



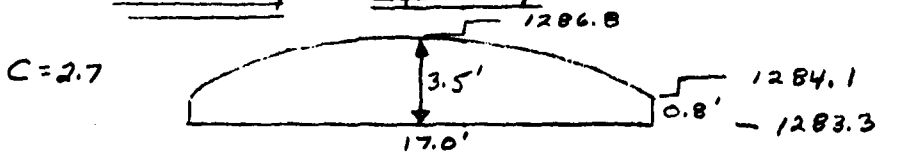
ORIFICE EQUATION USED IN PHASE I REPORT

$Q = CA\sqrt{2gh}$ $A = 250\square'$ $C = 0.8$

h = POOL ELEV $- \left(\frac{1285.3 + 1282.8}{2}\right)$ = POOL - 1284.05

POOL ELEV	Q (CFS)
1282.8	0
1283.0	35
1283.3	140
1284.0	519
1285.0	1289
1285.3	1561
1286.0	2240
1286.1	2298
1287.0	2756
1288.0	3189
1295.0	5309

AUXILIARY SPILLWAY 17e:



SEE NEXT SHEET

6313

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT LAKE SCRANTON FILE NO.
SHEET NO. OF SHEETS
FOR AUXILIARY SPILLWAY - CONTINUED
COMPUTED BY DATE CHECKED BY DATE

ASSUME ADJUSTED CRITICAL DEPTH

$Q = \frac{2.7}{3.1}\sqrt{\frac{A^3 g}{T}}$ A AND T ESTIMATED FROM PAGE C-5, PHASE I REPORT

AUXILIARY SPILLWAY: $hv = V^2/2g$ $V = Q/A$

W.S. ELEV	INCREMENT A	TOTAL A	T	Q	Q×11	hv	POOL ELEV
1283.3		0	17	0	0	0	83.3
	13.6						
1284.1		13.6	17	60.1	661.1	.3	84.4
	15						
1285.1		28.6	13	209.6	2306	1.1	86.2
	10.75						
1286.1		39.35	8.5	418.3	4601	1.8	87.9
	3				↑ FINAL Q		↑ POOL ELEV.
TOP OF ARCH		42.35					

FOR FOLLOWING USE ORIFICE EQUATION

$Q = C A \sqrt{2gH}$ $A = 424 \times 11$ $C = 2.8$

H = POOL − $\left(\frac{1286.8 + 1283.3}{2}\right)$

Q×11	POOL ELEV
7891	92.0

ABOVE EL 1292
INCLUDE 390' LONG ROAD
TOP OF ARCHES EL 1292 — 14,914 — 95.0
C = 2.7

6313

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

COMBINED RATING CURVE
INTERPOLATING BETWEEN POINTS COMPUTED

POOL ELEV	CFS Q MAIN SPILL.	CFS Q AUX. SPILL.	CFS TOTAL Q
1282.8	0 ✓	0 ✓	0
1283.3	140 ✓	0 ✓	140
1284.0	519 ✓	421 *	940
1285.0	1289 ✓	1209 *	2498
1286.1	2298 ✓	2215 *	4513
1288.0	3189 ✓	4681 *	7870
1292.0	4400 *	7891 ✓	12291
1295.0	5309 ✓	14914 ✓	20223

* INTERPOLATED FROM TABLES ON PREVIOUS PAGES

Data for Dam at Outlet of Subarea A2

Name of Dam: LAKE SCRANTON Sheet 3 of ___

Storage Data: FROM PHASE I REPORT + ADDED DATA

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
1180.9 = ELEVO*	0	0	0	
1282.8 = ELEV1	225 = A1	2490	7642 = S1	
1286.1	230			
1300	272			
**				

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Top of Dam is 23 percent of UNCONTROLLED watershed.

Remarks: ___

SUSQUEHANNA River Basin

Name of Stream: STAFFORD MEADOW BROOK

Name of Dam: NO. 5

~~NDS ID No.~~: _____

~~DER ID No.~~: _____

Latitude: N 41° 21' 40" Longitude: W 75° 40' 15"

Drainage Area: 12.0 sq. mile

Data for Subarea: A2 (see Sketch on Sheet C-4)

Name of Dam at Outlet of Subarea: LAKE SCRANTON

Drainage Area of Subarea: 7.2 OF WHICH 1.5 UNCONTROLLED sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = 1.3 mile

L_{CA} = Length of Main Watercourse to the centroid = 0.91 mile

From NAB Data: AREA 11 PLATE E

Cp = 0.62

C_T = 1.50

$Tp = C_T \times (L \times L_{CA})^{0.3}$ = 1.58 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 2.3 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

Data for Dam at Outlet of Subarea A3
(see Sketch on Sheet C-4)

Name of Dam: NO.5 Sheet 1 of __

Height: 35 FEET (existing)

Spillway Data:	Existing Conditions	Design Conditions
Top of Dam Elevation	929.2	929.5
Spillway Crest Elevation	RATING OF DAM	922.2
Spillway Head Available (ft)	BASED ON DESIGN CONDITIONS	7.3
Type Spillway	OGEE-TYPE CREST	
"C" Value - Spillway	3.50	3.50 *
Crest Length - Spillway (ft)	86.1	86.1
Spillway Peak Discharge (cfs)		5940
Auxiliary Spillway Crest Elevation	NONE	NONE
Auxiliary Spillway Head Available (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spillway		
Crest Length - Auxiliary Spillway (ft)		
Auxiliary Spillway Peak Discharge (cfs)		
Combined Spillway Discharge (cfs)		5940

Spillway Rating Curve:

* FROM WATER SUPPLY COMMISSION ESTIMATE

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)

Data for Dam at Outlet of Subarea A3

Name of Dam: NO.5 Sheet 2 of __

Outlet Works Rating:	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet	895.1		
Invert of Inlet	NOT AVAILABLE		
Type	CIP		
Diameter (ft) = D	2		
Length (ft) = L	118		
Area (sq. ft) = A	3.14		
N	.014*		
K Entrance	0.5		
K Exit	1.0		
K Friction* $= 29.1 n^2 L/R^{4/3}$	1.70		
Sum of K	3.20		
$(1/K)^{0.5} = C$	0.56		
Maximum Head (ft) = HM	34.4		
$Q = C A \sqrt{2g(HM)}$ (cfs)	83		
Q Combined (cfs)	± 80		

* CHOW

* R = Hydraulic Radius = (Area/Wetted Perimeter) = D/4 for Circular Conduits.

Data for Dam at Outlet of Subarea A3

Name of Dam: NO.5 Sheet 3 of ___

Storage Data:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
892.1 = ELEVO*	0	0	0	
922.2 = ELEV1	9.8 = A1	32	98.2 = S1	
940	42**			

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Top of Dam is NEGL percent of watershed.

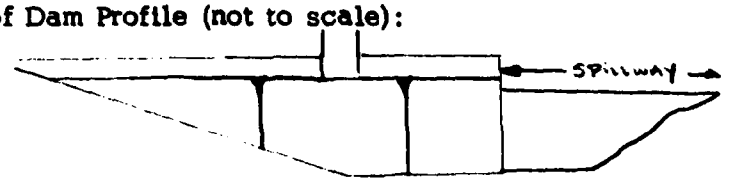
Remarks: _____

Data for Dam at Outlet of Subarea A 3

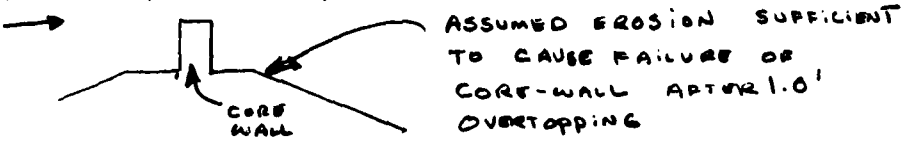
Name of Dam: NO. 5 Sheet 4 of __

Breach Data:

Sketch of Dam Profile (not to scale):



Sketch of Top of Dam (not to scale):



Soil Type from Visual Inspection: SANDY SILT

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) NOT USED fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H)

HMAX = $(4/9\ V^2/C^2)$ = NOT USED ft., C = NOT USED
1.0 929.5
HMAX + Top of Dam Elev. = 930.5 = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = 85 ft (width of bottom of breach)

Z = 1 (side slopes of breach)

ELBM = 894.5 (bottom of breach elevation, minimum of zero storage elevation)

WSEL = 922.2 (normal pool elevation)

T FAIL = 12 mins

= 0.2 hrs (time for breach to develop)

SUSQUEHANNA River Basin

Name of Stream: STAFFORD MEADOW BROOK

Name of Dam: NO.5

~~NDS ID No.~~: _____

~~DER ID No.~~: _____

Latitude: N 41° 21' 40" Longitude: W 75° 40' 15"

Drainage Area: 12.0 sq. mile

Data for Subarea: A3 (see Sketch on Sheet C-4)

Name of Dam at Outlet of Subarea: NO.5

Drainage Area of Subarea: 4.8 sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = 2.6 mile

L_{CA} = Length of Main Watercourse to the centroid = 1.5 mile

From NAB Data: AREA 11 PLATE E

Cp = 0.62

C_T = 1.5

$Tp = C_T \times (L \times L_{CA})^{0.3}$ = 2.26 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 7.2 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

SELECTED COMPUTER OUTPUT

ITEM	PAGE
MULTI-RATIO ANALYSIS	
INPUT	C-20 TO C-21
SYSTEM PEAK FLOWS	C-22
WILLIAMS BRIDGE DAM	C-23
LAKE SCRANTON DAM	C-24
NO. 5 DAM	C-25
BREACH ANALYSIS(1) (2) (3) FOR 50% PMF	
INPUT	C-26 TO C-28
SYSTEM PEAK FLOWS	C-29 TO C-30
NO. 5 DAM	C-31
STREAM SECTIONS	C-32

(1) PEAK FLOWS VARY SLIGHTLY FROM MULTI-RATIO ANALYSIS BECAUSE OF DIFFERENT ΔT FOR HYDROGRAPHS

(2) WILLIAMS BRIDGE AND LAKE SCRANTON OUTPUT NOT INCLUDED BECAUSE IT WAS ASSUMED THAT THEY WOULD NOT FAIL.

(3) PLAN 1 - NO FAILURES
PLAN 2 - NO. 5 DAM FAILS

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************
    1              A1                    NATIONAL DAM INSPECTION PROGRAM
    2              A2                      STAFFORD MEADOW BROOK
    3              A3                    NO. 5 DAM
    4              B    300        0       15        0        0        0        0        0       -4        0
    5              B1     5
    6              J      1        6        1
    7              J1     1       .5       .4       .3       .25      .2
    8              K      0        1                                          1
    9              K1       RUNOFF INTO WILLIAMS BRIDGE
   10              M      1        1      5.7                12.0
   11              P              21.7      116      125      134      141      143
   12              T                                                         1.0      .05               .01
   13              M   2.64     0.62
   14              X   -1.5     -.05      2.0
   15              K      1        1                                          1
   16              K1       ROUTE THROUGH WILLIAMS BRIDGE
   17              Y                                 1
   18              Y1     1                                                -1360.6      -1
   19              Y41360.6  1361.6   1362.6   1364.6   1366.2   1368.6
   20              Y5     0      177      827     3110     5560    10039
   21              $A     0       43       44       76
   22              $E1288.5  1360.6   1366.2   1380.0
   23              $S1360.6
   24              $D1366.2      3.0      1.5      650
   25              K      1        2                                          1
   26              K1       WILLIAMS BRIDGE ROUTE DOWNSTREAM
   27              Y                                 1
   28              Y1     1                                                  -1
   29              Y6    .15      .08      .15     1300     1320     1900     .021
   30              Y7     0     1360      100     1340      200     1320      390     1300      690     1320
   31              Y7   570     1340      710     1360      900     1380
   32              K      0        2                                          1
   33              K1       UNCONTROLLED RUNOFF INTO LAKE SCRANTON
   34              M      1        1      1.5                12.0
   35              P              21.7      116      125      134      141      143
   36              T                                                         1.0      .05               .23
   37              M   1.58     0.62
   38              X   -1.5     -.05      2.0
   39              K      2        2                                          1
   40              K1       OUT. WILLIAMS + UNCONTROLLED
   41              K      1        3                                          1
   42              K1       ROUTE THROUGH LAKE SCRANTON
   43              Y                                 1
   44              Y1     1                                                -1282.8      -1
   45              Y41282.8  1283.3   1294.0   1285.0   1286.1   1288.0   1292.0   1295.0
   46              Y5     0      140      960     2498     4513     7870    12291    20223
   47              $A     0      225      230      272
   48              $E1180.0  1282.8   1286.1     1300
   49              $S1282.8
   50              $D1286.1
```

C-20

NO. 5

(2) No. 5

```
SL      1      290      290
SV1286.1   1290.1     1295
K       1        4                                                    1
K1        STREAM SECT. NO 4
Y                                    1
Y1      1                                                           -1
Y6    .15      .09      .15     1140     1160     6150     .013
Y7       0     1300      350     1200      500     1160      550     1140      730     1140
Y7     810     1160     1300     1180     1900     1300
K       1        5                                                    1
K1        STREAM SECT. NO 5
Y                                    1
Y1      1                                                           -1
Y6    .15      .09      .15     1060     1080     4100     .029
Y7       0     1200      500     1100      620     1080      680     1060     1010     1060
Y7    1100     1100     1220     1180     1330     1200
K       1        6                                                    1
K1        DOWNSTREAM SECT. NO 6
Y                                    1
Y1      1                                                           -1
Y6    .15      .09      .15      960      980     3900     .021
Y7       0     1100      330     1000      360      980      500      960      620      979
Y7     621      980      650     1000      980     1200
K       0        6                                                    1
K1        UNCONT. RUNOFF INTO NO.5
M       1        1      4.8              12.0
P              21.7      116      125      134      141      143
T                                                          1.0      .05
W    2.26     0.62
X    -1.5     -.05      2.0
K       2        6                                                    1
K1        COMBINE OUT LK SCR AND UNCONT.
K       1        7                                                    1
K1        ROUTE THROUGH NO. 5
Y                                    1
Y1      1                                                  -922 2      0
SA      0      9.8       42                                           -
SE 892.1   922.2      940
SS 922.2     86.1      3.5      1.5
SD 929.5      3.1      1.5      257
K      99
```

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .50	RATIO 3 .40	RATIO 4 .30	RATIO 5 .25	RATIO 6 .20
HYDROGRAPH AT	1	5.70	1	12714.	6357.	5086.	3814.	3179.	2543.
	(	14.76)	(	360.03)(	180.02)(	144.01)(	108.01)(	90.01)(	72.01)(
ROUTED TO	1	5.70	1	12506.	6274.	4992.	3738.	3087.	2470.
	(	14.76)	(	354.13)(	177.65)(	141.35)(	105.85)(	87.41)(	69.93)(
ROUTED TO	2	5.70	1	12486.	6262.	4989.	3738.	3087.	2469.
	(	14.76)	(	353.57)(	177.33)(	141.27)(	105.86)(	87.41)(	69.92)(
HYDROGRAPH AT	2	1.50	1	4380.	2190.	1752.	1314.	1095.	876.
	(	3.88)	(	124.03)(	62.02)(	49.61)(	37.21)(	31.01)(	24.81)(
2 COMBINED	2	7.20	1	15792.	7917.	6291.	4711.	3878.	3101.
	(	18.65)	(	447.18)(	224.19)(	178.14)(	133.39)(	109.81)(	87.81)(
ROUTED TO	3	7.20	1	14058.	6704.	5291.	3914.	3217.	2494.
	(	18.65)	(	398.07)(	189.84)(	149.84)(	110.84)(	91.10)(	70.63)(
ROUTED TO	4	7.20	1	14029.	6681.	5273.	3896.	3200.	2482.
	(	18.65)	(	397.26)(	189.18)(	149.30)(	110.32)(	90.61)(	70.29)(
ROUTED TO	5	7.20	1	14007.	6671.	5266.	3894.	3190.	2476.
	(	18.65)	(	396.64)(	188.91)(	149.11)(	110.26)(	90.34)(	70.11)(
ROUTED TO	6	7.20	1	13994.	6666.	5259.	3886.	3185.	2474.
	(	18.65)	(	396.27)(	188.75)(	148.92)(	110.03)(	90.18)(	70.05)(
HYDROGRAPH AT	6	4.80	1	11636.	5818.	4654.	3491.	2909.	2327.
	(	12.43)	(	329.48)(	164.74)(	131.79)(	98.84)(	82.37)(	65.90)(
2 COMBINED	6	12.00	1	23000.	10949.	8641.	6317.	5115.	3967.
	(	31.08)	(	651.28)(	310.05)(	244.67)(	178.88)(	144.85)(	112.32)(
ROUTED TO	7	12.00	1	22876.	10915.	8613.	6287.	5100.	3955.
	(	31.08)	(	647.77)(	309.08)(	243.88)(	178.04)(	144.42)(	112.01)(

SUMMARY OF DAM SAFETY ANALYSIS

Williams Bridge Dam

15
No. 5

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1360.60	1360.60	1366.20
STORAGE	1033.	1033.	1277.
OUTFLOW	0.	0.	5560.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1369.92	3.72	1455.	12506.	5.50	42.50	0.00
.50	1366.58	.38	1294.	6274.	2.00	42.50	0.00
.40	1365.83	0.00	1261.	4992.	0.00	42.50	0.00
.30	1365.01	0.00	1225.	3738.	0.00	42.50	0.00
.25	1364.58	0.00	1206.	3087.	0.00	42.75	0.00
.20	1364.04	0.00	1182.	2470.	0.00	42.75	0.00

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	12486.	1313.4	42.50
.50	6262.	1310.4	42.50
.40	4989.	1309.5	42.75
.30	3738.	1308.5	42.75
.25	3087.	1307.9	42.75
.20	2469.	1307.3	42.75

16
NO.5

SUMMARY OF DAM SAFETY ANALYSIS

LAKE SCRANTON DAM

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1282.80	1282.80	1286.10
STORAGE	7643.	7643.	8393.
OUTFLOW	0.	0.	4513.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1290.51	4.41	9436.	14058.	8.25	43.25	0.00
.50	1287.27	1.17	8664.	6704.	4.50	43.50	0.00
.40	1286.53	.43	8493.	5291.	2.75	43.50	0.00
.30	1285.77	0.00	8318.	3914.	0.00	43.75	0.00
.25	1285.39	0.00	8231.	3217.	0.00	43.75	0.00
.20	1285.00	0.00	8141.	2494.	0.00	44.00	0.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	14029.	1149.0	43.50
.50	6681.	1145.8	43.75
.40	5273.	1145.1	43.75
.30	3896.	1144.3	44.00
.25	3200.	1143.8	44.00
.20	2482.	1143.3	44.25

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	14007.	1065.0	43.50
.50	6671.	1063.2	43.75
.40	5266.	1062.8	44.00
.30	3896.	1062.3	44.00
.25	3190.	1062.1	44.25
.20	2476.	1061.7	44.25

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	13994.	975.1	43.75
.50	6666.	971.5	44.00
.40	5259.	970.5	44.00
.30	3886.	969.3	44.25
.25	3185.	966.7	44.25

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SUMMARY OF DAM SAFETY ANALYSIS

NO. 5 DAM

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	922.20	922.20	929.50
STORAGE	98.	98.	206.
OUTFLOW	0.	0.	5944.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	940.13	10.63	531.	22876.	9.50	43.25	0.00
.50	933.15	3.65	292.	10915.	6.00	43.25	0.00
.40	931.55	2.05	251.	8613.	4.50	43.25	0.00
.30	929.78	.28	212.	6287.	1.75	43.50	0.00
.25	928.79	0.00	192.	5100.	0.00	43.50	0.00
.20	927.76	0.00	173.	3955.	0.00	43.50	0.00

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION 26 FEB 79
**********************************
A1              NATIONAL DAM INSPECTION PROGRAM
A2                STAFFORD MEADOW BROOK
A3              NO. 5 DAM
B      300       0       6       0       0       0       0       0      -4       0
B1       5
J        2       1       1
J1      .5
K        0       1                                       1
K1        RUNOFF INTO WILLIAMS BRIDGE
M        1       1     5.7             12.0                               1
P              21.7    116     125      134
T                                                        1.0     .05             .01
W     2.64    0.62
X     -1.5    -.05     2.0
K        1       1                                       1
K1        ROUTE THROUGH WILLIAMS BRIDGE
Y                                1       1
Y1       1                                           -1360.6      -1
Y41360.6  1361.6  1362.6  1364.6  1366.2  1368.6
Y5       0     177     827    3110    5560   10039
$A       0      43      44      76
$E1298.5  1360.6  1366.2  1380.0
$$1360.6
$D1366.2     3.0     1.5     650
$$     100       1    1300       1  1360.6    1400
$$     100       1    1300       1  1360.6    1400
K        1       2                                       1
K1        WILLIAMS BRIDGE ROUTE DOWNSTREAM
Y                                1       1
Y1       1                                                -1
Y6     .15     .08     .05    1300    1320    1900    .021
Y7       0    1340     100    1340     200    1320     300    1300     400    1320
Y7     570    1340     710    1360     900    1380
K        0       2                                       1
K1        UNCONTROLLED RUNOFF INTO LAKE SCRANTON
M        1       1     1.5             12.0                               1
P              21.7    116     125      134
T                                                        1.0     .05             .23
W     1.58    0.62
X     -1.5    -.05     2.0
K        2       2                                       1
K1        OUT. WILLIAMS + UNCONTROLLED
K        1       5                                       1
K1        ROUTE THROUGH LAKE SCRANTON
Y                                1       1
Y1       1                                           -1282.8      -1
Y41282.8  1283.3  1284.0  1285.0  1286.1  1288.0  1292.0  1295.0
Y5       0     140     [illegible]49    2498    4513    7570   12291   20223
$A       0     22[illegible]     230     272
$E1282.8  1282.8  1286.1    1300
```

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101   Y6    .15     .07     .15     880     900    2400    .017
102   Y7      0     280     620     920     500     900     520     880    1050     880
103   Y7   1140     900    1200     760    1280    1000
104   K       1       9                                       1
105   X1      DOWNSTRM SECT. 9
106   Y                               1       1
107   Y1      1                                              -1
108   Y6    .15     .07     .15     860     850     950    .021
109   Y7      0    1000     100     940     290     830     350     660     910     860
110   Y7   1050     380    1110     960    1600    1000
111   K       1      10                                       1
112   X1      DOWNSTRM SECT 10
113   Y                               1       1
114   Y1      1                                              -1
115   Y6    .15     .07     .15     840     980    7350  .00272
116   Y7      0    1000     500     900     690     860     820     840    1210     840
117   Y7   1340     860    1450     880    1850    1000
118   K       1      11                                       1
119   X1      SECT 11 DAMAGE CENTER
120   Y                               1       1
121   Y1      1                                              -1
122   Y6    .08     .06     .03     800     820    1800    .011
123   Y7      0     860     450     840    1050     920    1350     900    1800     800
124   Y7   1900     920    2100     840    2900     860
125   K      99
```

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50
HYDROGRAPH AT	1	5.70 (14.76)	1	6353. (179.89)(
			2	6353. (179.90)(
ROUTED TO	1	5.70 (14.76)	1	6321. (179.00)(
			2	6321. (179.00)(
ROUTED TO	2	5.70 (14.76)	1	6317. (178.89)(
			2	6317. (178.89)(
HYDROGRAPH AT	2	1.50 (3.88)	1	2206. (62.47)(
			2	2206. (62.47)(
2 COMBINED	2	7.20 (18.65)	1	8016. (226.98)(
			2	8016. (226.98)(
ROUTED TO	3	7.20 (18.65)	1	6653. (188.40)(
			2	6653. (188.40)(
ROUTED TO	4	7.20 (18.65)	1	6632. (187.78)(
			2	6632. (187.78)(
ROUTED TO	5	7.20 (18.65)	1	6625. (187.60)(
			2	6625. (187.60)(
ROUTED TO	6	7.20 (18.65)	1	6618. (187.40)(
			2	6618. (187.40)(

			2	5327.
			(	165.01)(
> COMBINED	6	12.00	1	10942.
	(	31.08)	(	309.84)(
			2	10942.
			(	309.84)(
ROUTED TO	7	12.00	1	10903.
	(	31.08)	(	309.72)(
			2	23794.
			(	673.77)(
ROUTED TO	8	12.00	1	10398.
	(	31.08)	(	308.59)(
			2	23008.
			(	651.52)(
ROUTED TO	9	12.00	1	10399.
	(	31.08)	(	309.61)(
			2	21234.
			(	601.27)(
ROUTED TO	10	12.00	1	10796.
	(	31.08)	(	305.71)(
			2	12248.
			(	346.93)(
ROUTED TO	11	12.00	1	10794.
	(	31.08)	(	305.64)(
			2	11930.
			(	337.22)(

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5C

SUMMARY OF DAM SAFETY ANALYSIS

NO. 5 DAM

PLAN 1 ••••• •••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	922.20	922.20	929.50
STORAGE	98.	98.	206.
OUTFLOW	0.	0.	5944.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	933.16	3.54	291.	10903.	5.80	19.20	0.00

PLAN 2 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	922.20	922.20	929.50
STORAGE	98.	98.	206.
OUTFLOW	0.	0.	5944.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	930.69	1.19	231.	27303.	.57	17.36	17.20

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PLAN 1 STATION 8

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	10898.	883.3	19.30

PLAN 2 STATION 8

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	23008.	885.2	17.40

PLAN 1 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	10899.	863.0	19.30

PLAN 2 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	21234.	864.5	17.40

PLAN 1 STATION 10

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	10796.	946.7	19.60

PLAN 2 STATION 10

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	12248.	847.2	17.60

PLAN 1 STATION 11

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	10794.	803.7	19.70

PLAN 2 STATION 11

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	11980.	803.9	17.70

SUMMARY OF PERTINENT RESULTS

PMF RAINFALL = 25.02"

	PMF	½ PMF
RUNOFF (INCHES - APPROXIMATE)	22.4	11.2

NO. 5 DAM:

INFLOW (CFS)	23,000	10,949
OUTFLOW (CFS)	22,876	10,915
DEPTH OVERTOPPING (FT)	10.63	3.65
DURATION OVERTOPPING (HRS)	9.50	6.00

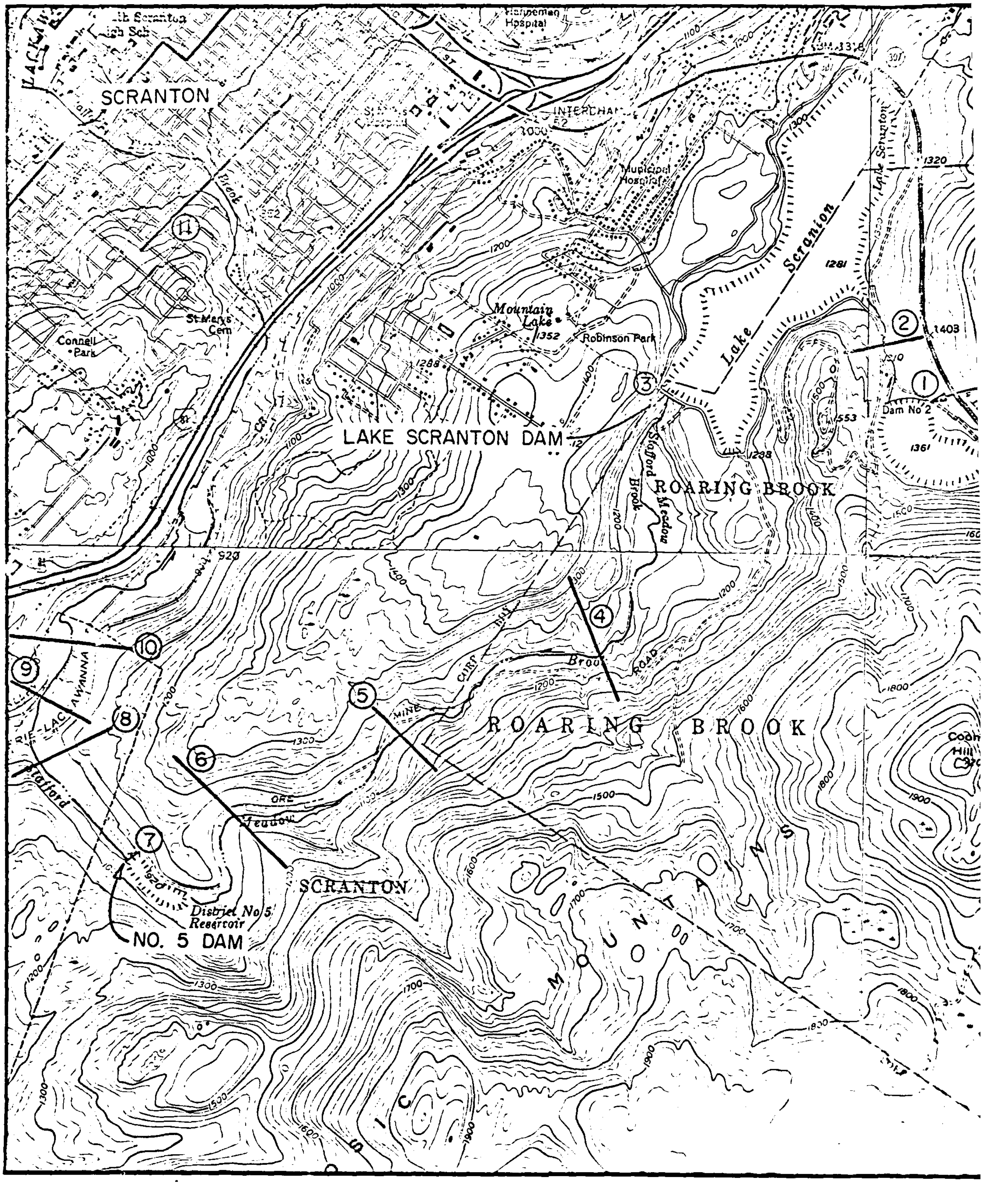
FROM BREACH ANALYSIS

CROSS SECT. NO.	DEPTH (NO FAILURE)	DEPTH (NO. 5 FAILS)	Δ DEPTH	
8	3.3	5.2	1.9	
9	3.0	4.5	1.5	
10	6.7	7.2	0.5	
11	3.7	3.9	0.2	DAMAGE CENTER

AT STATION 11 THE RATIO OF PEAK FLOWS WITH AND WITHOUT FAILURE IS $\frac{11980}{10794} = 1.109$

USING $Q = C\sqrt{H}$ PRESSURE PIPE FLOW

$$\frac{Q_1}{Q_2} = \sqrt{\frac{H_1}{H_2}} \Rightarrow \frac{Q_1^2}{Q_2^2} = \frac{H_1}{H_2} = (1.109)^2 = 1.23$$


SCRANTON
LAKE SCRANTON DAM
Lake Scranton
Mountain Lake
Robinson Park
Municipal Hospital
St Marys Cem
Connell Park
Dam No 2
ROARING BROOK
ROARING BROOK
SCRANTON
District No 5 Reservoir
NO. 5 DAM
MOUNTAINS
1
2
3
4
5
6
7
8
9
10
11

AD-A079 025 GANNETT FLEMING CORDDRY AND CARPENTER INC HARRISBURG PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. NUMBER 5 DAM (NDI ID NUMBER PA--ETC(U)
APR 79 A C HOOKE DACW31-79-C-0015

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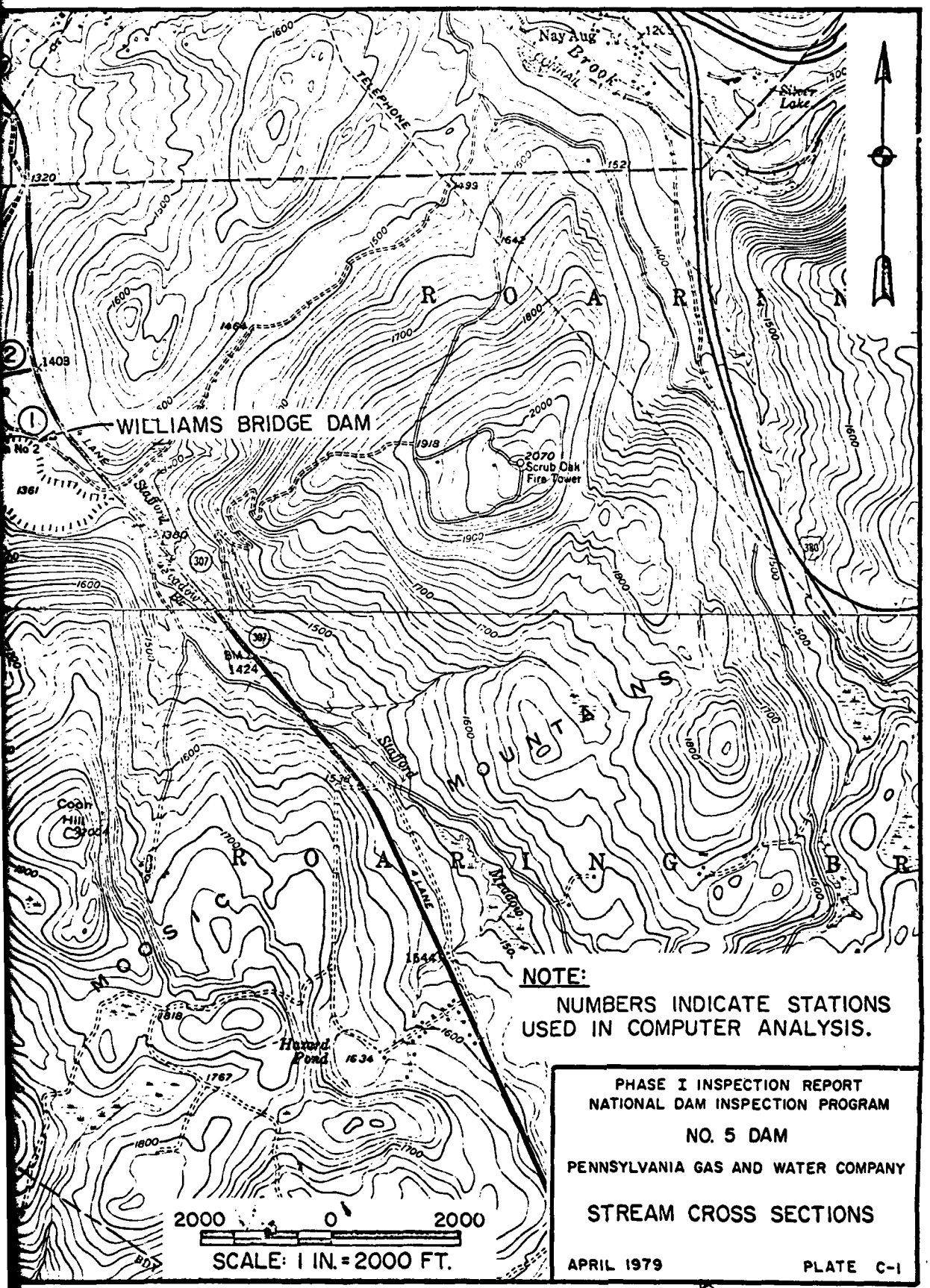


NOTE:

NUMBERS INDICATE STATIONS USED IN COMPUTER ANALYSIS.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NO. 5 DAM

PENNSYLVANIA GAS AND WATER COMPANY

STREAM CROSS SECTIONS

APRIL 1979 PLATE C-1

SUSQUEHANNA RIVER BASIN

STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

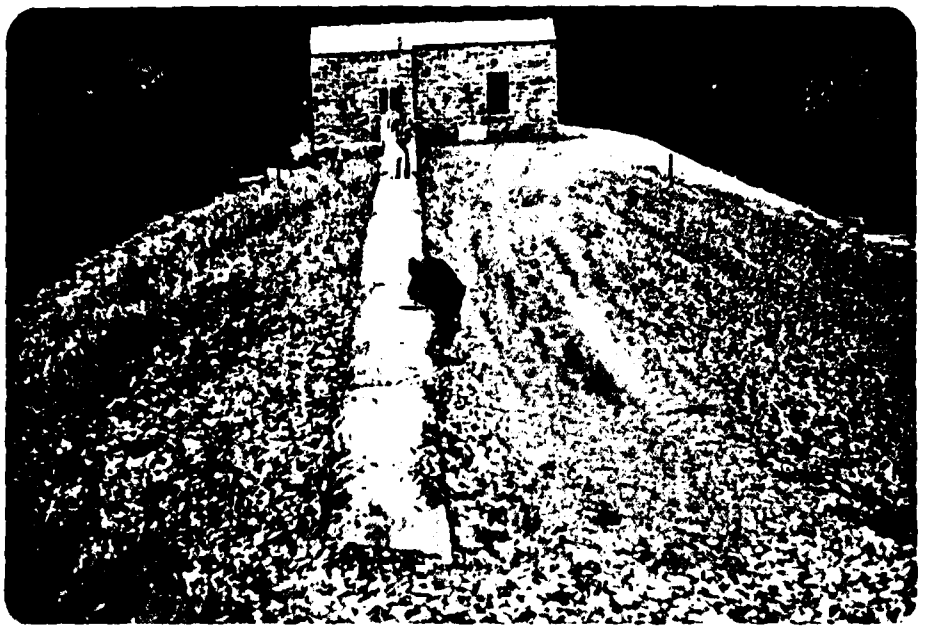
PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

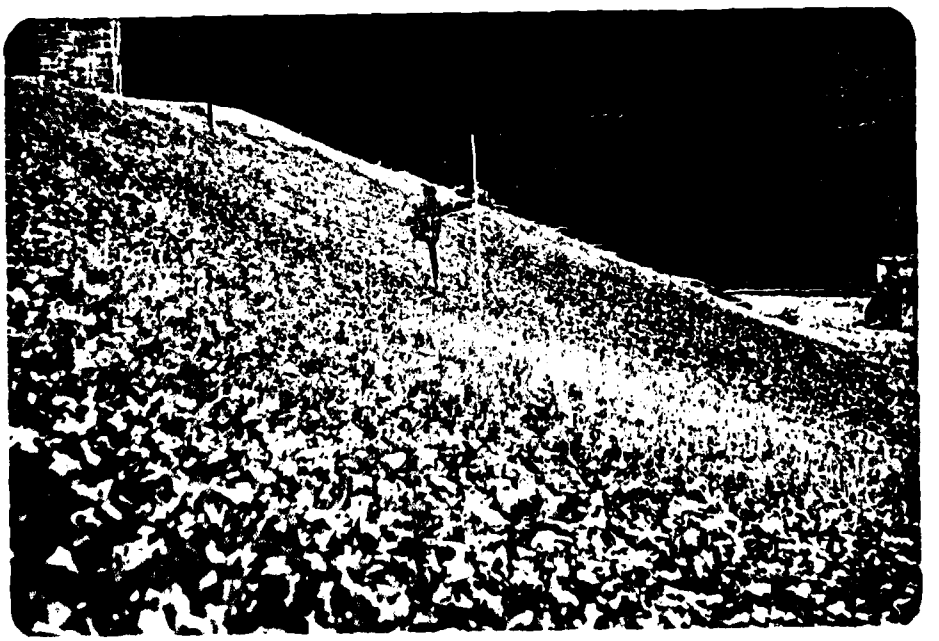
APRIL 1979

APPENDIX D

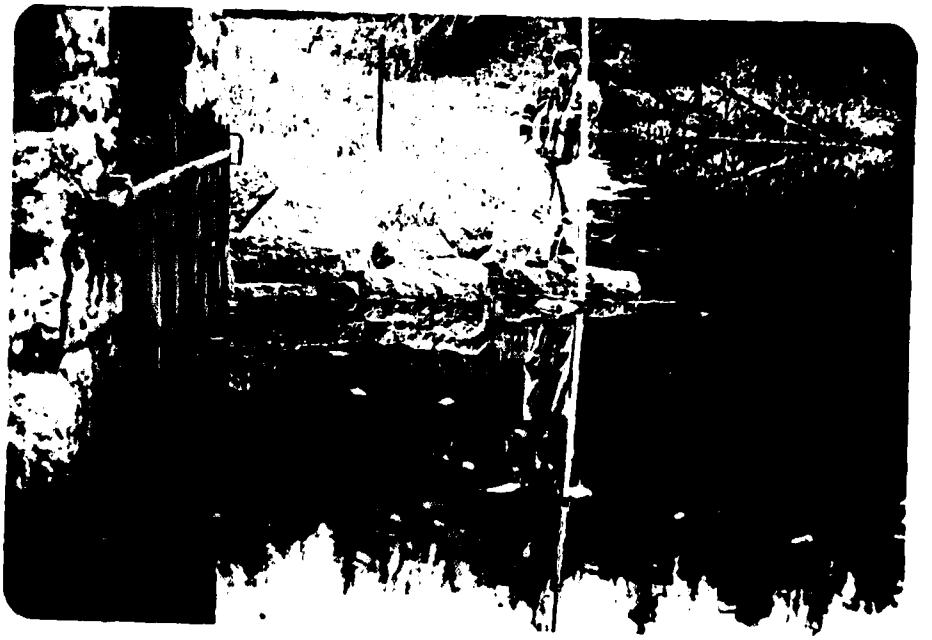
PHOTOGRAPHS



A. Top of Dam - from Right Abutment

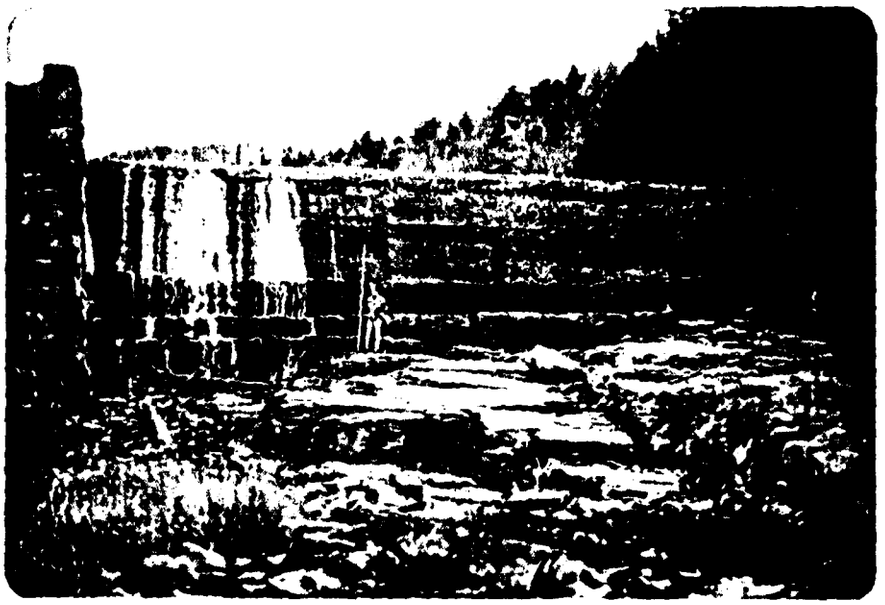


B. Downstream Slope



C. Upstream Slope and Intake Structure

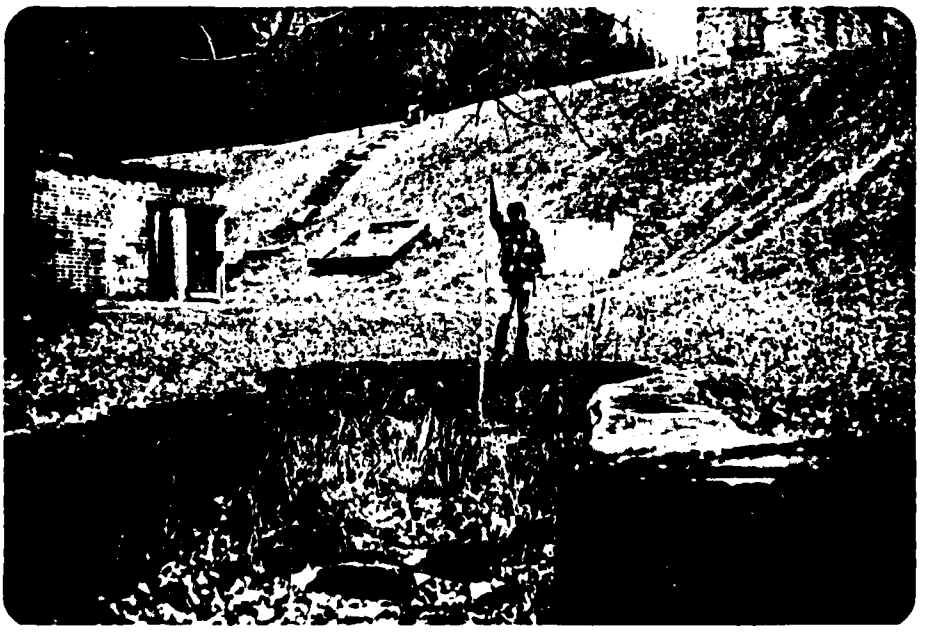
D. Core Wall



E. Spillway

F. Spillway Crest

G. Spillway Training Wall



H. Outlet Works Outfall

SUSQUEHANNA RIVER BASIN

STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

APPENDIX E

GEOLOGY

NO. 5 DAM

APPENDIX E

GEOLOGY

1. General Geology. The damsite and reservoir are located in Lackawanna County. Lackawanna County was completely covered with ice during the last continental glaciation of Pleistocene time. The general direction of ice movement was S. 35° - 40° W. Glacial drift covers the entire County, except where subsequent erosion has removed it. Thick deposits of glacial outwash occur in many places along the Lackawanna River, and are 50 to 100 feet thick near Dickson, Scranton, and Moosic.

The only important structural feature in Lackawanna County is the Lackawanna Syncline, which traverses the County in a southwesterly direction. The syncline enters the County at the northeast corner as a narrow shallow trough, gradually deepens and broadens toward the southwest, and reaches its maximum development in Luzerne County. The rock formations exposed range from the post-Pottsville, Mauch Chunk shale, Pocono sandstone to the Damascus formation of the Catskill group (oldest). The rim rocks, the Pottsville formation and Pocono sandstone, have dips that rarely exceed 10° to 20° and form a rather simple syncline. The core rocks, the post-Pottsville formations, are folded into a series of minor anticlines and synclines which trend about N 70° E. The rocks in the northwestern and southeastern parts of the County, outside of the limits of the Lackawanna Syncline, are generally horizontally stratified.

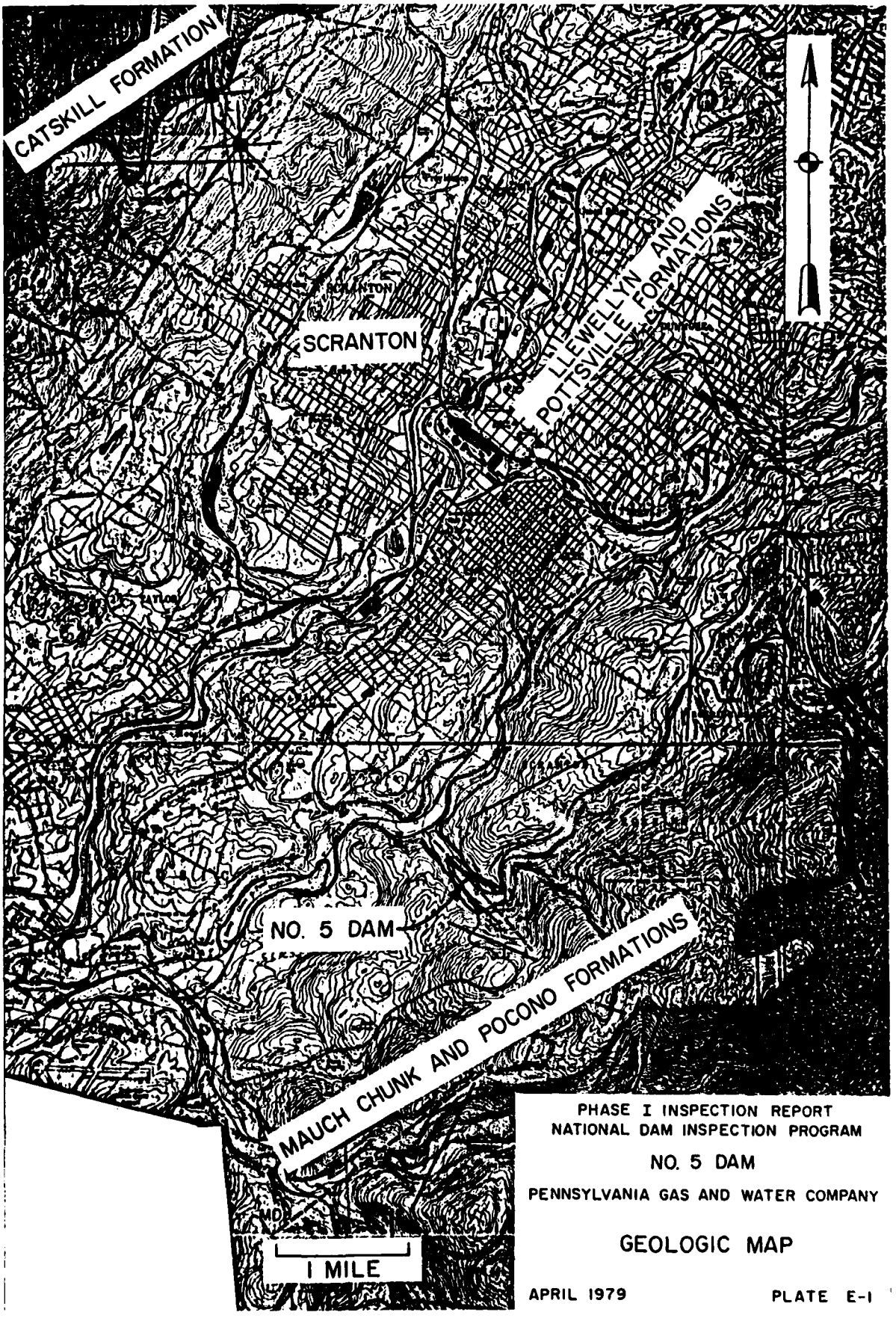
The Lackawanna River, in general, follows the axis of the Lackawanna Syncline. Southeast of the Lackawanna River, the rise in terrain is quite gradual and the crests of the high mountains are several miles from the Lackawanna River. Streams, such as Little Roaring Brook, Stafford Meadow Brook, and Spring Brook, have cut deep canyons through the mountains and follow a torturous course to their confluence with the Lackawanna River near Scranton, Pennsylvania. Northwest of Lackawanna River, the mountains rise abruptly to a sharp ridge which in most places is somewhat higher than the country to the northwest. Consequently, most of the drainage in this part of the County flows westward by way of Tunkhannock

Creek. A few small tributary streams, however, such as Leggetts Creek, flow eastward from this area into Lackawanna River. In the area of interest, the Lackawanna River streambed is founded in post-Pottsille formations. Proceeding uphill from the river, the older Pottsville formation, Mauch Chunk shale, Pocono sandstone, and Catskill continental group are encountered in turn. The tributary streams, in flowing down the mountains, have generally cut through or around the hard sandstone and conglomerate members, and have eroded their streambed into the softer shales and glacial till. The Catskill continental group of rocks underlies the greater part of Lackawanna County.

2. Site Geology. No. 5 Dam is founded on conglomerate of late Mississippian Age on the left end and a hardpan in the Pennsylvanian Pottsville Formation on the right end of the Pennsylvania Water Supply Commission Report of 1914 states that:

> "The Geological formation at the dam site is similar to that at the two other dams along the stream. On the south side a bastard conglomerate outcrop follows across the valley to the original stream channel, where it drops off abruptly, and the remainder of the valley and the opposite bank is a hardpan formation."

The Pottsville Formation is composed of gray, fine grained to coarsely conglomeratic sandstone; gray shales, limestone and coal. Bedding is generally well developed ranging in thickness from thin shale laminate to several feet in the sandstones. The Mississippian Mauch Chunk Formation is primarily a calcareous red shale with some interbedded fine to medium grained sandstones. Bedding is moderately well developed with abundant sedimentary features. Shale exposures in the formation are extremely susceptible to weathering while the sandstone and siltstone beds appear to be only slightly weathered.



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NO. 5 DAM

PENNSYLVANIA GAS AND WATER COMPANY

GEOLOGIC MAP

APRIL 1979

PLATE E-1